FLIGHT and The AIRCRAFT ENGINEER

First Aeronautical Weekly in the World : Founded 1909

Editor C. M. POULSEN

Managing Editor G. GEOFFREY SMITH

Chief Photographer JOHN YOXALL

Editorial, Advertising and Publishing Offices: DORSET HOUSE, STAMFORD STREET, LONDON, S.E.1
Telegrams: Truditur, Sedist, London. Telephone: Waterloo 3333 (35 lines).

8-10, CORPORATION ST., COVENTRY. *Telegrams:* Autocar, Coventry. *Telephone:* Coventry 5210.

GUILDHALL BUILDINGS, NAVIGATION ST., BIRMINGHAM, 2. *Telegrams:* Autopress, Birmingham. *Telephone:* Midland 2971 (5 lines).

260, DEANSGATE, MANCHESTER, 3. *Telegrams:* Iliffe, Manchester. *Telephone:* Blackfriars 4412.

26B, RENFIELD ST., GLASGOW, C.2. *Telegrams:* Iliffe, Glasgow. *Telephone:* Central 4857.

SUBSCRIPTION RATES: Home and Abroad: Year, £3 1 0. 6 months, £1 10 6. 3 months, 15s. 3d.
Registered at the G.P.O. as a Newspaper.

No. 1706. Vol. XL. SEPTEMBER 4th, 1941. Thursdays, One Shilling.

The Outlook

Hints from Australia

NEWS from Canberra states that Lieut. Gen. Sir Iven Mackay, who commanded the Australian troops in the Libyan campaign and is now Commander-in-Chief of the Australian Army, may give evidence before a secret session of the Commonwealth Parliament following on criticisms which he is said to have made. Among these criticisms is one concerning lack of co-operation between the Army and the Air Force, and he is said to have declared that co-operation between the two in the Middle East must be developed to the same standard as that of the Germans. Mr. Spender, the Defence Minister, is reported to have said that steps had been taken to ensure that object.

This may portend that in the future part or all of the Royal Australian Air Force in the Middle East may be placed, not under the command of the A.O.C.-in-C., Royal Air Force, but under the G.O.C. of the Australian Army there. That would be a big departure from previous practice, but it might be a salutary one. At home here there is doubt as to whether the Army is assured of sufficient air support when it next takes the field against the Germans, and in particular there is doubt as to whether the British Army is possessed of officers of high rank who are sufficiently versed in air matters to know just what the Army ought to insist on having. Of course, there are in all Services officers who have passed through the Imperial Defence College, there are Air Force officers on the instructional staff at Camberley, and there are Army officers on the staff of the R.A.F. Army Co-operation Command. Despite all this, it is not easy to feel confident that all is well with this important matter.

The Advance Into Iran

ONCE more it has been shown how very useful air reconnaissance machines and bombers are to an army. The advance into Iran would not, it was hoped, lead to fighting, at any rate to any serious fighting. That hope in the main was justified, and after the Government which had shown itself unwilling to take adequate steps against German infiltration had resigned, the new Prime Minister ordered the Iranian troops to cease from any form of opposition.

But naturally there was at first some doubt as to what lay before our troops, and there was in particular some anxiety about the great oil works and the safety of the fairly large British community which is congregated round them. So air-borne troops were sent ahead to make sure of their safety, which they were able to do.

Of course, both the columns of British and Indian troops have Air Components with them. One of these columns arrived by sea, presumably from India, and landed at the head of the Persian Gulf near to Hamadan. The other column marched in from Iraq, and the troops in Iraq are now under the Commander-in-Chief in India, General Sir Archibald Wavell. We may recall that before the war all the British forces in Iraq were under the Air Officer Commanding, but war has brought changes, temporary it may be, and the contingent of the Air Force in Iraq has long ago been placed under the R.A.F. Middle East Command; while since the revolt the Army troops have been under the administration of India. At the moment it is not clear who gave the order for the R.A.F. in Iraq to move into Iran.

Iran is a mountainous country, and the Anglo-Indian forces in the north, i.e., at Khanikin, had to traverse

the Paitak Pass, which might be strongly held. Air reconnaissance found Iranian artillery in position there, and they were heavily bombed. Then the passage was undisputed. Elsewhere R.A.F. machines destroyed a few obsolete machines of the Hart type belonging to Iran, while other machines dropped leaflets on Teheran and other cities which told all and sundry that the British had no sinister designs against their country and would rob the people of nothing.

Jet Propulsion

IN view of the amount of attention which inventors and designers have devoted to the subject, it is somewhat surprising how little the general public, and indeed aviation circles which should be better informed, know about jet propulsion. Some two years ago *Flight* decided to look into the matter, and as a first step invited Dr. Lanchester to write for us a series of articles dealing with the theoretical side of jet and exhaust efflux propulsion (which is another aspect of the same phenomenon). Four of his articles appeared during November and December, 1939, and in August of last year there was another, on "boost." More recently Dr. Lanchester has devoted attention to a detailed examination of rocket propulsion, his first article appearing on August 7th of this year, and the second in this issue.

While Dr. Lanchester has given our readers the benefit of his calculations and conclusions, we ourselves have devoted much time and patience to a search for information concerning the work that has been done by others, in Europe and in America. This search has borne considerable fruit, and in our issue of August 28th we published the first of a series of articles dealing with our discoveries in this field. Other articles will follow, and we hope to show that, probably to the surprise of most people, the day of practical jet propulsion of aircraft may not be so very far off.

In this connection it is necessary to distinguish clearly between two forms of jet propulsion: that in which the thermodynamic engine is a closed vessel or container having an escape nozzle for the gases. This container is filled with some combustible mixture, which is of such a nature that it is self-sufficient, or in other words does not need to be supplied with oxygen from outside.

The other form of thermodynamic jet propulsion engine is that in which the fuel used (it may be liquid or solid) requires the addition of air for its combustion.

Superficially one would say that the jet-propulsion power plant should be simpler and more efficient than the petrol engine cum airscrew combination. There must obviously be a compressor of some sort, but apart from that the number of moving parts should be small.

That the direct-reaction engine wins on the score of simplicity seems obvious. On an efficiency basis it is less easy to compare the two, largely because it is difficult to ascertain the horse-power of the jet-propulsion plant. It is known that this form of propulsion is not very efficient at low forward speeds, but that at high speeds it becomes much better.

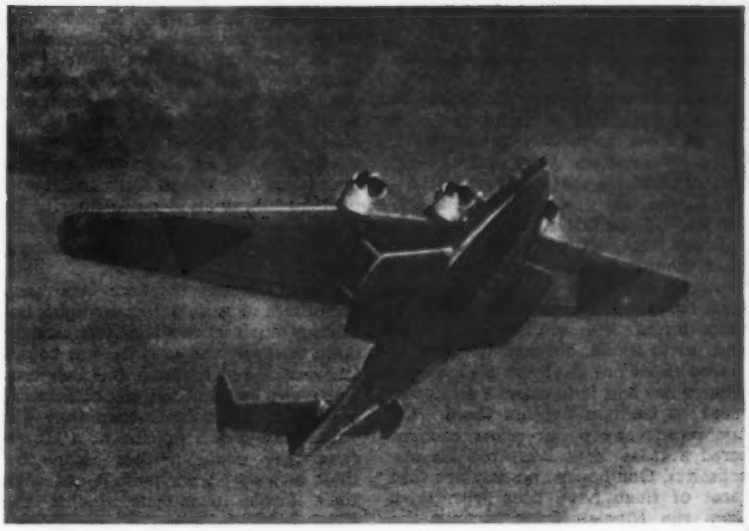
In aircraft propulsion, thrust multiplied by speed is the criterion of horse-power, and as jet propulsion becomes efficient at high speeds, and the installation lends itself to clean aerodynamic design, it seems reasonable to assume that the efficiency, in the form of thrust delivered at high speeds for a given consumption of fuel, may in time be made to compare not unfavourably with the petrol engine-airscrew combination.

We have come to look upon modern aero-engines as very efficient. Actually, the percentage of heat units converted into thrust is very low, and the conversion follows a roundabout route which spells mechanical complication. If we assume that the efficiency of the petrol engine is of the order of 25-30 per cent., an airscrew efficiency of 75 per cent. will result in a thrust horse-power of only some 20 per cent., or one-fifth of the energy contained in the fuel.

NOT ENTIRELY BLACKED OUT Civil aviation, though its work has been severely restricted since the outbreak of war, still provides many of the essential communications for this country. The new air mail service established between England and Northern Ireland on September 1st is being carried by Railway Air Services in their DH 86s. Passengers are here seen embarking in their blacked-out aeroplane "under the eye of the military."

War in the Air

The Advance Into Iran : Budyonny's Retreat : The Cross-Channel Fighting



FAR EAST SPOTTERS' PROBLEM : A Dornier Do 24 flying boat belonging to the Royal Dutch Navy in Batavia. It is identical with those used by the Germans except for the international markings.

LAST week's most important news did not concern fighting, or at least much fighting, but the almost peaceful entry of British and Russian troops into Iran. The Russians came down from the North and with great speed occupied Tabriz, Ardebil and both shores of the great lake of Urmia. The British forces formed part of the Army in India and so were under the general command of our old friend General Wavell. The troops, as in all such operations, were composed of both British and Indian regiments. Naturally, contingents of the R.A.F. accompanied them, and these seem to have included squadrons of army co-operation machines and of bombers. The British forces entered the country at two points. One force from India came by sea up the Persian Gulf and landed at Bandar Shapur, near the great oil refinery at Abadan. The other force advanced by land from Iraq and crossed the coast at Khanikin. The reason for choosing this spot is that it is on one of the few great trunk roads which traverse Iran, this one running through Kermanshah, Hamadan and Kazvin to Teheran, the capital. Air-borne troops were at once sent on ahead to secure the safety of the British employees at the oil works, and the following troops speedily ejected all Iranian soldiery from the neighbourhood of those works. From Abadan there is another trunk road which joins the above-mentioned one at Hamadan.

Resistance on the part of the Iranian troops was slight. But the road from Khanikin winds through the high range of the Zagros Mountains by means of the Paitak Pass. In the initial advance only a few shots were fired and the opposition was brushed aside at the cost of one Gurkha wounded. But the aircraft scouted ahead and found Iranian artillery in position on the pass, so they bombed their gun positions heavily. Other R.A.F. machines dropped leaflets over Teheran and the other chief towns of the country explaining that we had no intention of conquering the land, but were only taking action against the large numbers of Germans who had taken up their abode in it and who obviously constituted a danger to Allied interests. A glance at a map shows that, now that Syria and Iraq are safely in British hands, Iran is the only way by which the Germans might force their way down into Asia, to threaten either India or the Suez Canal or both. Iran is also the only land route by which Britain can expeditiously send munitions into Russia, and, of course, stuff from the U.S.A. can also come up the Persian Gulf and thence overland into Russian hands.

When our troops advanced, the opposition in the Paitak Pass was not serious, and the Simla communiqué said that it was swept away. The Iranian Government which had permitted the influx of Germans resigned, and the new Government ordered all its forces to desist from resistance.

News from the Russian front at the moment of writing is inconclusive. It seems that Marshal Budyonny has succeeded in withdrawing most of his army across the Dnieper river, abandoning the rich country of the Ukraine. How much the Germans will profit by that gain is not clear. They will certainly get industrial areas but may not be able to lay their hands on the grain harvest, which they greedily desired. But though the Ger-

RUSSIAN SCRAP HEAP : The remains of a number of I 16 fighters left behind on an aerodrome during a retreat.

WAR IN THE AIR

mans obviously have been anxious to secure spectacular gains of territory and of cities to mollify their public, their broadcasters were undoubtedly correct in saying that what really mattered was to destroy the Russian armies. If the latter can retreat as a fighting force, with supply bases behind them (information on that point is vague, but there are believed to be such bases in their rear) the vast German forces will remain committed and, so to speak, entangled.

One effect our daylight sweeps over France has had is to cause a reinforcement of German fighters there. On one recent sweep our pilots encountered a mass of at least 100 Messerschmitts. One hopes and assumes that most of them have been withdrawn from the Russian front because the Germans in the West could not tolerate the damage which our escorted bombers were doing to such targets as the Potez works, and had to take steps to give them more protection. A thinning out of fighters on the German eastern front must mean that the Red Air Fleet will find things easier, both in defending its own interests and in attacking the German columns. There have been many tales told of how the Panzer divisions have been held up and largely destroyed by attacks of Russian bombers. As for the *Luftwaffe's* bomber force, the Russians have certainly cut down its strength by a lot.

Raw German Crews

FOR a good many weeks past the only attention paid to Great Britain at nights has been by individual machines which have not pressed far inland and have dropped a few bombs on or near coast towns, doing little damage and causing few casualties. London has been left to sleep in peace —though one must never forget that before these words are published something may have happened to falsify them. Anyway, the behaviour of the German airmen now in France suggests that they are raw crews sent out to do jobs which do not entail much risk or make heavy demands on the navigators, but which gently break the men in to the typical German amusement of killing civilians in their beds. Naturally enough, all the best German bomber crews are on the eastern front.

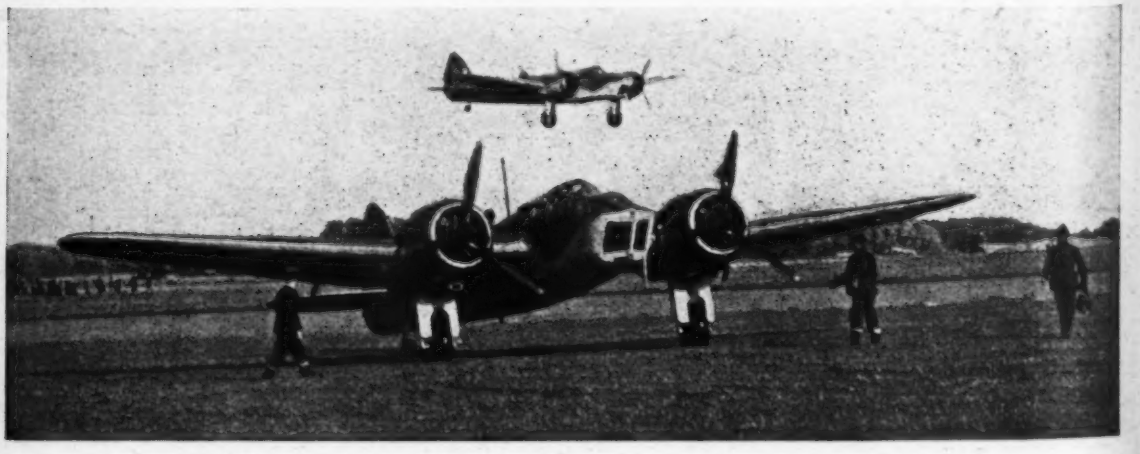
These German bombers in France sometimes venture out in daylight, behaving much as the Heinkels used to do in the early stages of the war before the invasion of Holland and Belgium. The crews had realised, doubtless with a painful shock, that when they got within range of a Spitfire or a Hurricane they could neither escape by their own speed nor fight it out with their feeble armament against the eight machine guns of the British fighter. So they kept near clouds, and hopped into cover on the slightest sign of danger. The same sort of thing is going on now. Not long ago two Hurricanes were on patrol off the South-west Coast when they sighted a German bomber about a mile ahead. The leader of the two Hurricanes came up to close range, when the enemy rear-gunner saw him and opened fire. The fighter pilot identified the aircraft as a Dornier, and he and his comrade attacked from alternate sides and saw their bullets tearing into the enemy's wings. The German bomber climbed towards cloud with the Hurricane leader firing into it. The cloud base was very low, and it was clear to both fighter pilots that the bomber stood a good chance of getting away. "I saw my comrade attacking from below," said the Hurricane leader. "He pressed home his attack until the Dornier was at cloud base and then, as it looked like disappearing, crashed straight into it. I saw a large part of his machine fall off after the collision and the rest dived into the sea. I circled the spot, and while doing so I saw the blazing Dornier plunge into the water."

Our enemy is unscrupulous. Three German aircraft violated neutral waters recently to attack a British merchant ship as she was lying off a Portuguese port waiting to enter. The attack occurred at a point off the land frontier of Portugal and Spain, and well within territorial limits. Because of this the crew of the British ship were taken by surprise, believing that the approaching machines must be either Portuguese or Spanish. But the aircraft attacked, dropping one bomb which fell near the ship and raking her with machine-gun fire. Fortunately, there were no casualties.

Over the Mediterranean

MUCH air activity is going on in Mediterranean waters, where the Germans and Italians in Libya need a constant supply of munitions and food of all sorts. The vessels which carry all this stuff come from Sicily, and on the way have to run the gauntlet of British submarines. The R.A.F. and the S.A.A.F. give a hand at times, but mostly take their turn by hammering away at the ports on the African coast—Tripoli, Bardia, and the rest. It must be especially annoying to the German and Italian Generals to see a tanker full of precious petrol or oil go up in flames, but they must be getting quite used to that sight now. Sometimes enemy fighters appear, and though they seldom have any luck in tackling Hurricanes or Tomahawks, they do occasionally get home on a bomber. The following story concerns a Maryland of the South African Air Force which was attacked by six Me 109s over Cyrenaica.

"We were on our way back from attacking an enemy aerodrome," said the pilot, "when one of my gunners reported 'fighters are on us' and then almost immediately afterwards 'they



IN THE BAG : Blenheims returning from an attack on the Knapsack power station, Cologne.

WAR IN THE AIR

are opening fire.' I turned to meet the attack head on and gained speed, making for land. Then we were hit. The aircraft caught fire and I gave the order to bale out, and circled around to enable the crew to jump. One gunner had been badly wounded at the start of the engagement and couldn't bale out. The other gunner lifted him up, only to find that the guns were in the way. The wounded man's harness caught in the gun sight, and the other gunner had to lift everything clear and drop the guns and the wounded man through the hatch. The injured man had just sufficient strength to pull the rip cord. While he was helping his comrade the other gunner's parachute caught on some projection and opened out inside the aircraft. With only a few seconds to spare, the sergeant gathered the billowing silk and cords in his arms, wrapped them around himself and, clutching on to them as tightly as he could, dropped himself through the hatch. Wrapped up in folds and cords, he had a terrible time trying to free himself as he hurtled towards the ground. He was struggling all the way down until at last, with only one thousand feet to spare, his parachute opened out. The shock when the parachute jerked clear was severe, and one of the shrouds still entangled round his right arm pulled his shoulder from the socket. The observer, two gunners, and myself all landed within a mile and a half of each other. The two injured men are doing well in hospital." The other men were not much the worse.

ENEMY AIR LOSSES TO AUGUST 30th.

	Over G.B	Over Continent	Middle East
Aug. 24	—	—	—
" 25	—	—	1
" 26	2	1	1
" 27	—	10	10
" 28	—	—	3
" 29	1	10	—
" 30	1	—	—
	4	21	15
	—	—	—

Totals: Northern Area, 5 280; over 2,075 Middle East.

BRITISH AIR LOSSES TO AUGUST 30th.

	Over G.B. Fighters	Over G.B. Pilots	Over Continent Aircraft	Middle East Aircraft
Aug. 24	—	—	4	—
" 25	—	—	6	—
" 26	—	—	14	—
" 27	—	—	8	3
" 28	—	—	21	2
" 29	—	—	15	—
" 30	—	—	5	—
	0	0	73	5

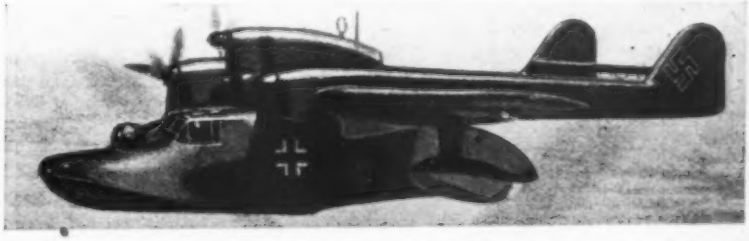
Totals: Northern Area, 2,616; about 370. Middle East.

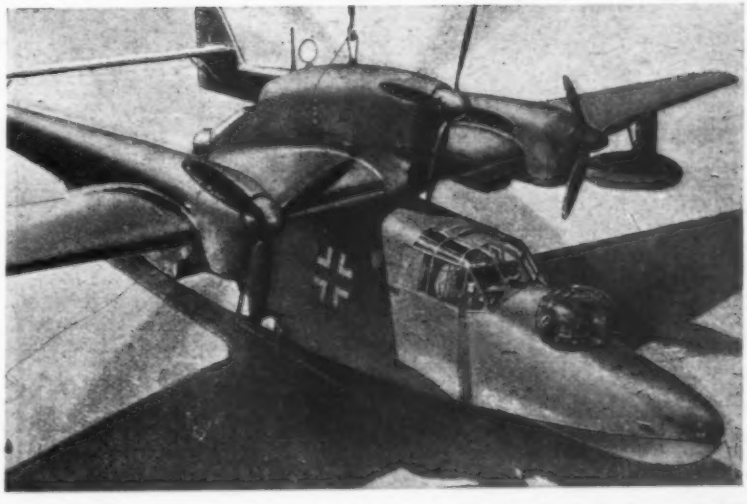
H.A. 138

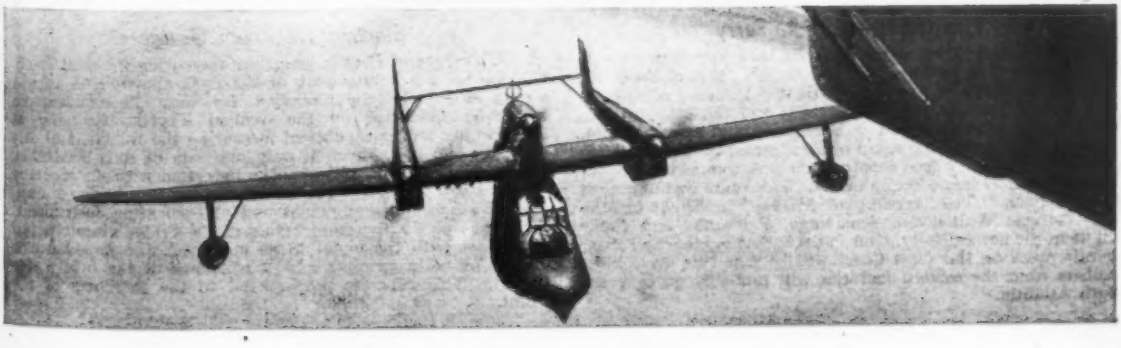
Three-engined Blohm and Voss Flying Boat

MORE unusual-looking than elegant, this new Blohm and Voss Ha 138 naval reconnaissance flying-boat is fitted with three Junkers-Diesel engines and, although no performance figures are available, it is reputed to have quite a useful range and speed. Probably in order to limit the height of the centre engine without sacrificing blade-area, a four-bladed airscrew is fitted. The outboard engines retain the more usual three-bladed type. The difference, however, may be accounted for by a more powerful centre engine.

Armament is said to include shell and machine guns, two gun positions being provided astern—one immediately behind the "upstairs" engine and another in the stern of the abbreviated hull—in order to provide an adequate field of fire in spite of the twin tail-boom design. Incidentally, the turret on the prow, apparently power-operated, is one of the first German types we have seen.







AIRSCREW DEVELOPMENTS

New Four-bladers and Counter-rotating Models Announced

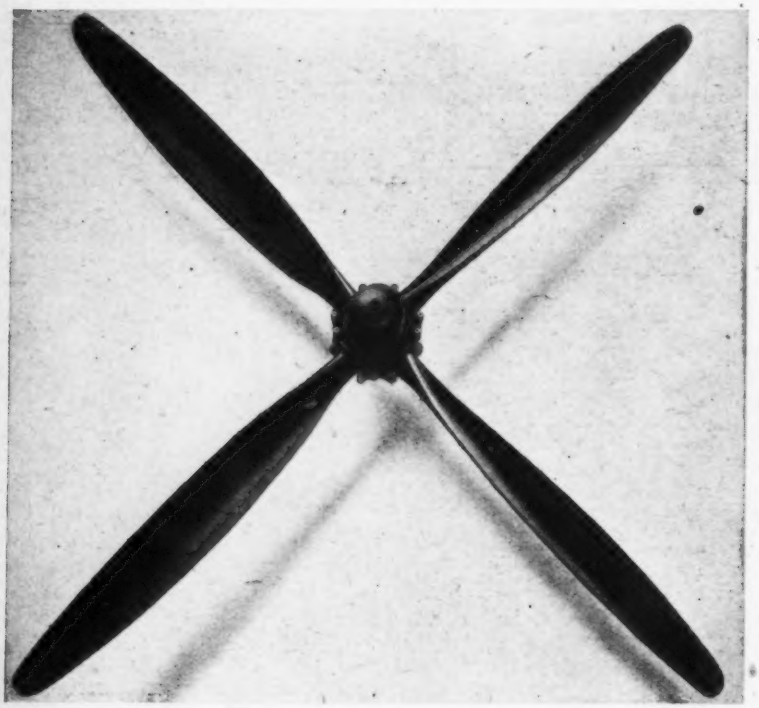
THE De Havilland Aircraft Co., Ltd., has obtained Air Ministry permission to announce the existence of two airscrew developments which have been proceeding in secrecy for a long time. One is the De Havilland all-metal four-bladed airscrew, and the other is the counter-rotating airscrew. Both have full constant-speeding and feathering action.

Both developments have arisen out of the phenomenal advance in the supercharging of big engines, increasing their operating altitude to such a degree that three blades cannot provide enough blade area to work effectively in the rarer atmosphere, except if the airscrew be made so large that it cannot be accommodated without unduly tall undercarriage legs.

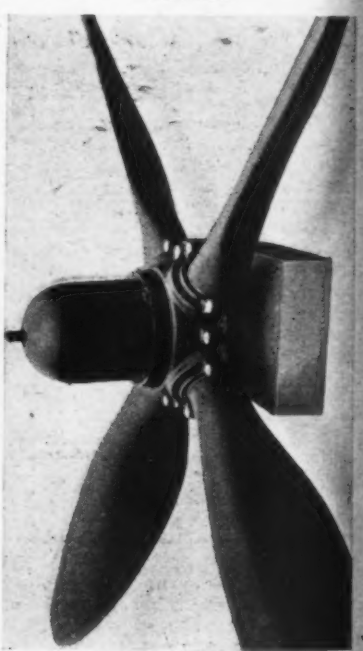
The first of the De Havilland four-bladed series was the size to suit engines of 2,000 h.p. and higher, the biggest engine the R.A.F. is using at present. This airscrew has a diameter of 16ft. Other sizes are being built covering the range of operational horsepowers. The four-blader embodies all the structural and mechanical principles that have proved their merit in millions of hours of flying in earlier De Havilland variable-pitch airscrews, the development and production of which has been undertaken by the company in this country since 1934.

An important feature is the use of metal blades. These make possible the thin blade sections necessary for obtaining the last ounce of efficiency, and also the relatively small blade roots which permit the use of a correspondingly small hub, with reduced weight and cleaner spinner profiling. Furthermore, in forced landings with undercarriage retracted, the strong, malleable duralumin blades can be relied upon to bend backward and form skis, protecting the main body of the engine and the whole airframe, and localising the damage. As for the blades themselves, 80 per cent. of those which are damaged in crashes or by gunfire (including those "holed" by bullets) are repairable.

The De Havilland counter-rotating double airscrew has three blades in each plane, and here again the familiar De Havilland actuating principles and construction, including the metal blades, are preserved. The airscrew is being made in a range of sizes, and its development proceeds in pace with the development of engine reduction gearing.



The new D.H. four-bladed airscrew, and (below) a larger view of the very neat hub.



The U.S.A.–U.S.S.R. Ferry

REPORTS from Washington indicate that American aircraft will be ferried to Russia by two routes. One of these will be by an extension of the South Atlantic-African route northward from Cairo into southern Russia, and the other will be across Canada, over the narrow Bering Sea and across Siberia. It would appear that the chain of aerodromes extending across Canada to Alaska, whose construction was commenced earlier this year, will be immediately useful. This route was described in our article, "The Territory of Alaska," in *Flight* of May 1st. Perhaps Whitehorse, Anchorage, Fairbanks and Nome will be in the news shortly. Our guess is that fighters and those aircraft made on the West Coast will be sent this way, while bombers from the eastern factories will probably go over the South Atlantic.

Electric Thickness Gauge

A NEW type of electric gauge for measuring the wall thickness of the hollow part of the light alloy blades of airscrews is described by *Canadian Aviation*. This instrument has been developed by the General Electric Company at Schenectady and is capable of measuring the thickness of any non-magnetic metal even if only one side of it is accessible. Thicknesses of up to 1½in. can be measured with an accuracy of about five per cent. The device consists of a bridge circuit, voltage amplifying equipment and an indicating instrument. When one of the two inductances of the bridge circuit is put in contact with the metal to be measured, the impedance is altered by eddy currents and the balance of the bridge disturbed. This effect is proportional to the thickness of the metal.

1941.

evelop-
ken by

These
obtain-
latively
ndingly
er pro-
arriage
can be
ting
ne, and
ves, so
or by
airable.
ew has
liar De
cluding
being
eeds in
ring.

screw,
very

ll thick-
of air-
trument
any at
of any
cessible.
ccuracy
circuit,
rument
t is put
lance in
dge dis-
of the

Second of the New Series

FRIEND or FOE?

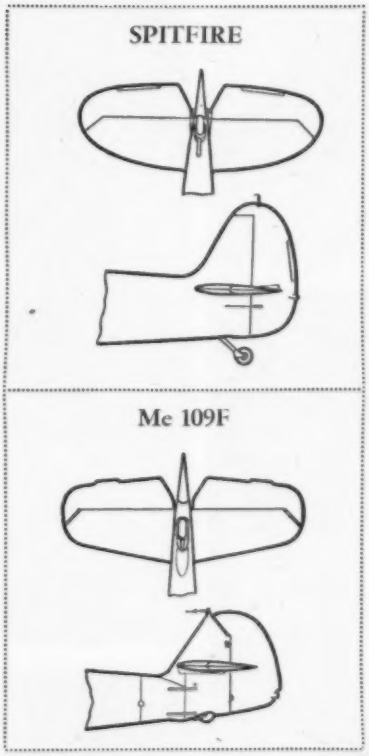
Two More Opposing Fighter Tail Units Compared

VICKERS SUPERMARINE SPITFIRE. Elliptical tailplane, set below base-line of fin and slightly forward. Gracefully curved fin and rudder of moderately high aspect-ratio ; inset trimming-tab. Fixed tailwheel.

IN selecting this week the Spitfire and the new Messerschmitt Me 109F we strike two rival fighters which, if the spotter be unable to catch a glimpse of the wing plan, will be none too easy to identify. Both have a slim fuselage with a rather flat top line, so that if seen passing across the line of vision at a distance they are very similar in general appearance. In each case, too, dihedral is from the wing roots and undercarriages retract outwards ; so even from a three-quarter rear view the resemblance persists.

This brings us down to a question of tail unit design if identity is to be established with certainty, especially if the excrescences beneath the centre-section are not seen with sufficient clarity, as might well happen under conditions which only showed the machine in silhouette. Unfortunately, any circumstance or set of circumstances which prevented a view of the wing plan would be only too likely also to preclude a view of tailplane plan. This would make identification all the more difficult because there is less difference between the outlines of their respective fins and rudders than there is between the shape of their tailplanes. In short, the only angle from which these two machines *obviously* differ is in full plan.

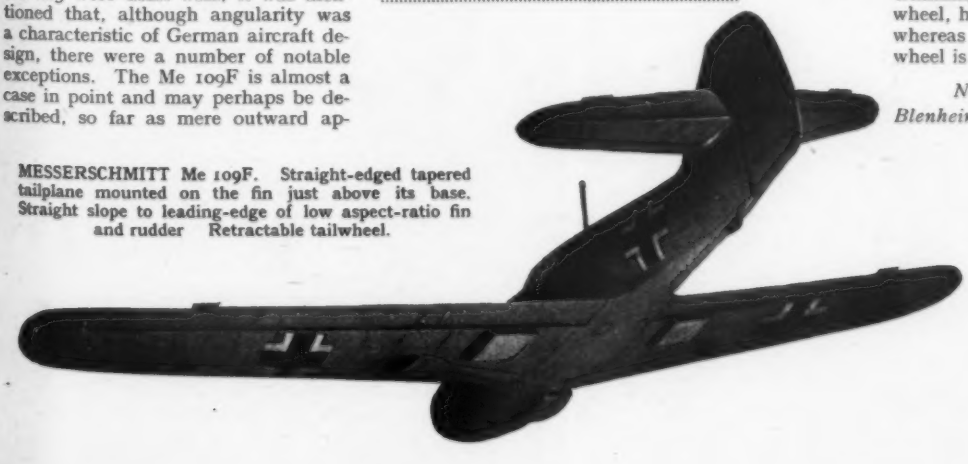
Last week, when the Hurricane and He 113 were dealt with, it was mentioned that, although angularity was a characteristic of German aircraft design, there were a number of notable exceptions. The Me 109F is almost a case in point and may perhaps be described, so far as mere outward appearance goes, as a 109E after a mild course of beauty treatment. Nevertheless, it still lacks the graceful curves of the Spitfire even though the bracing struts have disappeared from beneath the tailplane and the wing tips are no longer square cut.



A glance at the pictures and drawings will show that the fin and rudder of the Spitfire is of higher aspect-ratio than those of the Me 109F. In the former case the base of the leading-edge makes a convex curve where it rises from the fuselage, whereas on the Messerschmitt it forms an abrupt angle. On the British machine there is a small but rounded apex from which the trailing-edge sweeps down to the base of the rudder-post in an unbroken curve. Contrast this with the Me, which has a straight slope to the leading-edge, a broad apex and a sharp corner at the lower extremity of the trailing-edge.

Immediately noticeable on the Me, also, is the positioning of the tailplane on the fin itself, a little back from the leading-edge and well above the thrust line. The Spitfire tailplane is mounted on the fuselage below the base-line of the fin and slightly farther forward. The plan of the Spitfire tailplane more or less matches that of its elliptical wings ; that of the Me has straight tapered edges and projecting trimming tabs. Its tailwheel, however, retracts, whereas the Spitfire tailwheel is fixed.

Next week : Blenheim IV and Ju88.



MESSERSCHMITT Me 109F. Straight-edged tapered tailplane mounted on the fin just above its base. Straight slope to leading-edge of low aspect-ratio fin and rudder Retractable tailwheel.

R.A.F. CA

Some Examples of the Work of One of Our Ment

CANVAS

of Our Accredited War Artists—Eric Kennington

Top left is A/C.1 Stroud, of the Maintenance Section of No. 74 Squadron. *Bottom left* is Flt. Lt. R. A. B. Learoyd, an old Wellington boy, who won the V.C. for his part in bombing the Dortmund-Ems canal from 150ft. *Bottom centre* depicts a Heinkel III in flames. The title is "Both Engines Were Hit." The picture at the *bottom right* is called "Night Fighter" and shows a Hurricane pilot seated in the cockpit with his face illuminated by the soft glow of the cockpit lighting.

The three portraits in the centre are—*left to right*—Wing Cdr. D. F. W. Atcherley, D.F.C.; Wing Cdr. B. E. Embry, D.S.O. (2 Bars), A.F.C.—who was shot down over St. Omer during the Battle of France and escaped from a German prisoners of war camp—and Sqn. Ldr. John Cunningham, of No. 604 County of Middlesex Squadron A.A.F., who received the first D.F.C. to be awarded for night-fighting on the 9th of January this year and the D.S.O. three months later.

R.A.F. CA

Some Examples of the Work of One of Our Ment

CANVAS

e of Our Commented War Artists—Eric Kennington

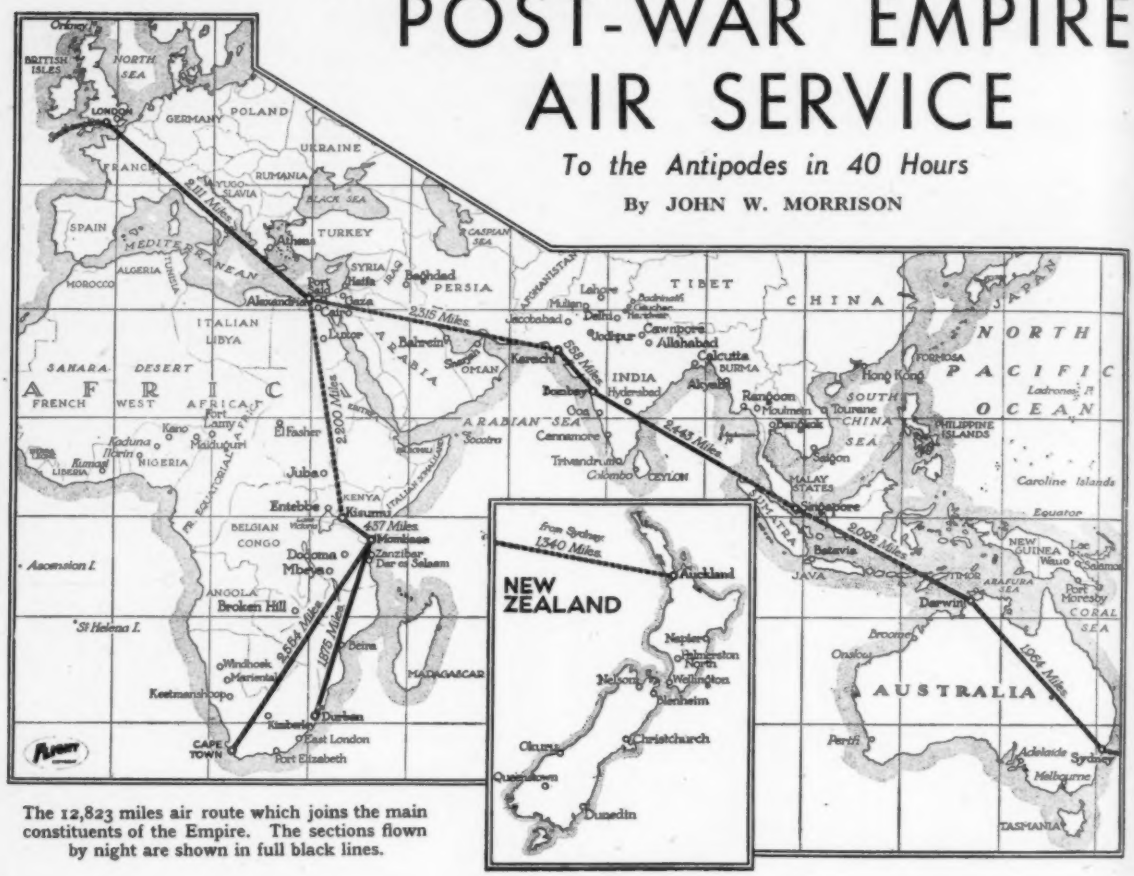
Top left is A.C.1 Stroud, of the Maintenance Section of No. 74 Squadron. *Bottom left* is Flt. Lt. R. A. B. Learoyd, an old Wellington boy, who won the V.C. for his part in bombing the Dortmund-Ems canal from 150ft. *Bottom centre* depicts a Heinkel III in flames. The title is "Both Engines Were Hit." The picture at the *bottom right* is called "Night Fighter" and shows a Hurricane pilot seated in the cockpit with his face illuminated by the soft glow of the cockpit lighting.

The three portraits in the centre are—*left to right*—Wing Cdr. D. F. W. Atcherley, D.F.C.; Wing Cdr. B. E. Embry, D.S.O. (2 Bars), A.F.C.—who was shot down over St. Omer during the Battle of France and escaped from a German prisoners of war camp—and Sqn. Ldr. John Cunningham, of No. 604 County of Middlesex Squadron A.A.F., who received the first D.F.C. to be awarded for night-fighting on the 9th of January this year and the D.S.O. three months later.

POST-WAR EMPIRE AIR SERVICE

To the Antipodes in 40 Hours

By JOHN W. MORRISON



The 12,823 miles air route which joins the main constituents of the Empire. The sections flown by night are shown in full black lines.

EFFORTLESS speed is the goal of all locomotion, whether it be 30 m.p.h. or 330 m.p.h. In any case, speed is only relative; when flying at high altitudes at between 300 m.p.h. and 400 m.p.h. there is little or no indication of speed for the reason that there is nothing by which to gauge it. By contrast, there is a very real sensation of speed if one drives one's car down a narrow lane at 30 m.p.h. due to the proximity of stationary objects.

The purpose of speed is essentially one of broadening and extending the horizons of mankind; of serving the people. Too often, speed is either misused or misunderstood, but for travelling the vast distances separating the Mother Country from the Dominions the high-speed aeroplane has a very definite place in the future scheme of things.

One has only to study *Flight's* excellent "World's Airline Map" closely to realise the unique and well-nigh boundless opportunities at our disposal for the development of our commercial aviation after the war, and the profound benefits to mankind resulting from a drawing together of our far-flung Empire.

Are we, as a nation, fully aware of this fact? We believe, nay, we are certain, that we are already winning the War in the Air; but what about winning the Peace in the Air? The R.A.F. has become a great multitude of young men, many among whom are irrevocably wedded to the aeroplane. We know what we owe to the earnest young men of the R.A.F., and knowing, is it not our sacred duty to see to it that those so minded be given an opportunity to win the Peace of the Air?

We need a bold plan for the future, an ambitious plan worthy of the greatness of the Empire. Dr. H. Roxbee Cox has already given us an eminently sound basic plan (28th Wilbur Wright Memorial Lecture) on which we can build with every confidence. The purpose of this article, therefore, is to "mock up" a few test sections of the ultimate completed edifice in order that it may be examined in some detail.

Immediately prior to the war there were in preparation a number of interesting British commercial aircraft, including the Fairey FC1 and the Short 14/38 transatlantic aircraft with pressurised cabins. While it was inevitable that work on commercial aircraft be suspended, it is fervently hoped that these two firms are continuing research work on pressurised cabins. The weakest link must be strengthened by all possible means.

A prominent American has stated that the De Havilland Albatross is the most beautiful commercial aeroplane in the world. Without a doubt, the "F" class airliner is an exceptionally fine example of unity. By that I mean the intimate union of engines and airframe to produce a harmonious whole that is not only pleasing to the eye, but spells Efficiency with a capital E. Not only this, but the whole design strikes one as an individual conception from end to end and an inspiration for the future.

The tendency towards high wing-loadings is most marked in the case of both the Lockheed 144-14 airliner and the more recently projected Consolidated 32 Landplane Transport (a civil version of the Liberator). A few figures taken from the specifications of these aircraft are given below:—

TABLE I

	Lockheed 144-14	Consolidated 32 L.T.
Wing area	1,000 sq. ft.	1,043 sq. ft.
Gross weight	43,000 lb.	47 000 lb.
Wing loading... ...	43.0 lb./sq. ft.	45.06 lb./sq. ft.
Power loading ...	8.96 lb./b.h.p.	9.79 lb./b.h.p.
Passengers	36	21
Max. speed	294 m.p.h. at 16,700ft.	335 m.p.h. (approx.).
Range	1,612 miles at 200 m.p.h.	3,000 miles (plus).

If the latter aircraft had a pressure cabin, four of the new P. & W. Twin Wasp engines developing 1,200 b.h.p at 23,000ft. would provide a top speed of at least 370 m.p.h. at this altitude. Still more interesting is the new Lockheed Constellation, developed by Howard Hughes and Jack Frye for T.W.A. and P.A.A. Jack Frye has said

POST-WAR EMPIRE AIR SERVICE

The Short 14/38, which was to have had special Hercules engines with turbo blowers. All-up weight was 71,000 lb.

that this new aircraft will ensure for the United States "virtual domination of the air from a commercial transport standpoint for several years to come." With a range of over 4,000 miles, the Constellation is said to have a top speed of 350 m.p.h. with 64 passengers, and to cruise at between 25,000ft. and 30,000ft. at 283 m.p.h. on only 47½ per cent. of power; the four engines develop 10,000 h.p.

Operational Speeds

Pan American Airways' decision to adopt landplanes for the transatlantic service in preference to flying-boats is interesting. Quite apart from the fact that ice and swells render a flying-boat service unsatisfactory, the gap between the speeds of flying-boats and landplanes is widening, due to the inferior aerodynamic shape of the former, the probable impracticability of pressurising the hull, and the greater frontal area and wetted area involved. The next big advance in operational speed will be to 300 m.p.h.; indeed this speed is already upon us. In order to have something in hand on the express Empire routes, I have set the optimum speed at a 300 m.p.h. average from take-off to touch-down, at just under 50 per cent. of take-off power.

In an article written just before the war ("The Short Transatlantic Aeroplanes," *Aeronautics*, Aug., 1939) Mr. C. P. Lipscomb graphically demonstrated the effect of cruising at high and low percentages of rated power. Fig. 5 of Mr. Lipscomb's article shows the payload available with a constant 3,000 miles range; Fig. 6, the range available with a constant payload of 8,800lb. The curves for the low altitude (10,000ft.) and high altitude (25,000ft.) aeroplanes are placed side by side, and I am taking the liberty of reproducing a few of the most interesting figures below:—

LOW ALTITUDE

Per cent. of Rated Power	Pay Load in lb.	Range in miles
71½	11,600	3,400
56	14,000	3,930
42	15,600	4,350

HIGH ALTITUDE

70	11,000	3,360
55	12,600	3,750

In the case of the low-altitude Short landplane, an increased payload of nearly two tons is realised by reducing speed from 245 m.p.h. to 185 m.p.h.; however, it is probable that the best compromise for this aircraft is to cruise at 220 m.p.h. on 56 per cent. of rated power. For the high-altitude version the best speed would appear to be 250 m.p.h. at 25,000ft. on 59 per cent. of power, the payload being almost exactly four tons for a range of 3,370 miles.

The effect of cruising at high and low speeds on the time between major overhauls is worthy of attention. Mr. Arthur Nutt, of the Wright Aeronautical Corporation, has given some useful figures in his paper before the World Automotive Engineering Congress of the S.A.E. at San Francisco, on June 7th, 1939. Cruising power given is a percentage of rated power:—

70 per cent. of power: time between overhauls: 275 to 420 hours.
55 " " " " " 500 to 700 "

Dr. Roxbee Cox has already put forward the idea for a fast through-service joining the main constituents of the Empire. The route suggested included the following stages: — Southampton-Alexandria, Alexandria-Karachi, Karachi-Singapore, Singapore-Darwin. Dr. Cox has further suggested that corresponding improvements appear possible on the trans-Africa route. The writer has given a good deal of attention to the possibility of an Empire air express operating over the route Southampton-Auckland, N.Z. (12,823 miles). My thanks are due to British Overseas Airways for having kindly given me nearly all the route mileages tabulated below:—

TABLE II

Southampton–Alexandria ...	...	2,111 miles.
Alexandria–Karachi ...	...	2,315 "
Karachi–Bombay ...	...	558 "
Bombay–Singapore ...	...	2,443 "
Singapore–Darwin ...	...	2,092 "
Darwin–Sydney... ...	...	1,964 "
Sydney–Auckland ...	...	1,340 "
Total ...		12,823 "

It was thought advisable to include a stop at Bombay for a number of reasons: First, the design of a suitable aircraft is governed by the longest stage of the route; secondly, the number of the crew depends on the flight-duration over the longest stage of the route, and, thirdly, Bombay would appear to be a more convenient stopping place than Karachi for most travellers to India. There is also an express trans-Africa route branching south from Alexandria. It is to be hoped that the interested parties will eventually come to some form of agreement over this route in order that the service may be extended to Capetown. The stages given are not altogether satisfactory:—

Alexandria–Kisumu ...	...	2,200 miles (approx.).
Kisumu–Mombasa ...	...	437 "
Mombasa–Durban ...	...	1,875 "

The last stage is of necessity a night flight and, to avoid too early an arrival in Durban, the speed would have to be reduced about 125 m.p.h. below maximum economical speed. The optimum stage is, in fact, Mombasa-Capetown (2,554 miles approximately) at 42 per cent. of take-off power.

Just as the Lockheed Constellation is designed around four of the new 2,500 b.h.p. Wright Duplex Cyclone engines, so also will the future British Empire express air-liner be designed around the finest and most powerful British aero engines available after the war.

POST-WAR EMPIRE AIR SERVICE

It would be foolish at this juncture to attempt to give the output of our most powerful engine in 194?, but I can say with conviction that an output of 2,600 b.h.p. at 26,000ft., with 3,000 b.h.p. available for take-off, is indicated for the Empire Express routes.

A four-engined airliner with a power loading of 8¾ lb./b.h.p., a wing loading of 47½ lb./sq. ft., and 3,000 b.h.p. engines would have a gross weight of 105,000 lb. and 2,210 sq. ft. of wing area. The speed with mid-wing arrangement would be around 400 m.p.h. at 28,000ft. at 94,000 lb. mean gross weight. In terms of sheer bulk, the 400 m.p.h. airliner would be no bigger than the A.W. Ensign, although the former would probably appear larger with an aspect ratio of 9.5 and a wing span of 145ft.

Is it better to place a high value on sheer size, or is it more desirable to concentrate on greater frequency of service with smaller aircraft? Undoubtedly, the largest possible aeroplane will give the greatest sense of security, but I think that a good case can be made out for a medium-sized plane for some time to come.

Engine Installation

High wing-loadings and low power-loadings are bound to affect the design of the medium airliner to a considerable degree in the future. The case for the normal four-engined installation in an airliner of not more than 60,000 lb. gross weight will become more and more difficult to justify solely on the score of enhanced reliability. Apart from the twin-engined installation, there are a number of alternative four-engined ones having a very low installation-drag that may be considered:—

(1) Four engines in two tandem nacelles driving two tractor and two pusher airscrews.

(2) Four engines in two tandems driving two-bladed double co-axially mounted tractor airscrews.

(3) Four vertically opposed engines arranged in two nacelles driving two-bladed double co-axially mounted tractor airscrews.

(4) Four special wing-submerged engines driving two four-bladed tractor airscrews through the intermedium of free-wheeling devices.

Of the above installations, both (1) and (2) are well known, (3) is simply a separated H-type "unitwin" engine available with 8, 12, 16, 24 and 32 cylinders. Naturally, the Broad H unitwin engine will be appreciably bulkier than the normal H engine of the same power, there being two complete sets of engine auxiliaries to accommodate. Strictly speaking, it is not a military engine, being justified mainly on the score of enhanced reliability.

The trial specification given below has reference to a mid-wing cantilever monoplane with circular section pressurised cabin and the engine arrangement given at (3).

TABLE III

Dimensions:		**Weights**	
Wing span	109 ft.	Gross	59,000 lb.
Length	79 ft.	Empty equipped	**34,500** lb.
Cabin diameter	11½ft.	Disposable load	**24,500** lb.
Areas:		Fuel (2,000 g.)	15,000 lb.
Wing	1,250 sq. ft. (gross).	Oil (140 g.)	1,250 lb.
Loadings:		Crew of 5	**1,000** lb.
Wing	47.20 lb./sq. ft.	20 passengers	4,800 lb.
Power	9.93 lb./b.h.p.	Mail, etc.	**2,450** lb.

Power Plant: two Broad H-24 unitwin 60-litre sleeve valve engines

Power (take-off)	6,000 b.h.p. at	3,000	r.p.m.
„ (26,000ft.)	5,200 „	3,000	„
Cruise 50 per cent. t.o.	3,000 „	2,200	„

Fuel Consumption: .435 lb./b.h.p./hr. ... 174 gals./hr. at 50 per cent. take-off.

Airscrews: 2-bladed double co-axially mounted, feathering.*

Diameter ... 16ft. 6in.

Speeds:

Maximum	385 m.p.h at 28,000ft.
Cruise at 50 per cent. t.o.	326 „ „

Range at 326 m.p.h. 3,600 miles.

Duration 11.55 hours.

The mid-wing arrangement appears destined to become increasingly popular in the future; the Short landplanes specified this arrangement and demonstrated that neither accommodation nor access through the cabin need suffer if the design is carefully thought out. In the Empire airliner under review the two-spar wing with spars at 20 per cent. and 47 per cent. chord is suggested. Ladies' and gents' toilets might be arranged between the spars. Flat oval 6ft. 3in. by 2ft. 6in. doors between fore and aft compartments will leave a generous amount of space above, below and on either side for bulb centre sections of tremendous strength.

Retraction of the tricycle undercarriage in a mid-wing design having a high wing-loading, high aspect-ratio and large diameter airscrews is a difficult proposition; in the design under review, inward retraction with two large wheels is most unattractive. The only solution would appear to be that of retracting twin wheels forward into the engine nacelles, which have an appreciably greater diameter than for a normal H-type engine—actually, about 52in.

The exhaust-driven turbo-supercharger would appear to be an indispensable component part of the high-altitude air-liner of the future by virtue of its ability to salvage waste power at height. In the case of the Broad H unitwin 24-cylinder engine, installation of these components ought to be more than usually straightforward, since all the exhaust stacks of each section of the engine are on the same side.

Excessive Drag

At the present time the man in the street is being made four-engine conscious, the virtues of the four-engined bomber are being extolled in the popular Press to such a degree that its aerodynamic inferiority is being lost sight of. However, the fact remains that the normal four-engined installation is beginning to look ridiculous and thoroughly out of proportion. In one instance, four single-row radial engines, each having a cowled diameter of nearly five feet, are installed in an aircraft having a wing span of only 95ft. The sum of the diameters of the engines is nearly 25 per cent. of the wing length either side of the fuselage. The installation-drag must be truly appalling! Germany, Italy and France are all well forward with double-engined aircraft and co-axially mounted airscrews. The case for the normal four-engined installation up to a gross weight of 60,000 lb. is now virtually untenable aerodynamically.

Having projected a practical ideal Empire Express airliner, we can now "give it a trial spin" over the 12,800-mile-long Great Britain-Australasian Express through route. In studying the ensuing time-tables the reader will find it helpful to do so in conjunction with the map which heads this article. This not only gives at a glance the inter-stage distances, but differentiates between the day and night sections, the former being shown by a dotted line and the latter by a black line. The time-table is worked out in such a

* Alt. 3-bladed: 14ft. 3in. diam.

The Fairey F.C.1 was designed to have a pressure cabin to take thirty passengers. Auxiliary lifting surfaces which retract into the main wing give increased lift for landing and take-off. A nose wheel undercarriage was part of the projected design.

The graceful lines of the De Havilland Albatross are shown in this *Flight* photograph. At the time of its inception the Albatross was experimental in both construction and its power plants.

way as to be especially attractive to business men, the loss in working time being at a minimum:—

TIME-TABLE I

Depart	G.M.T.	Local Time	Arrive	G.M.T.	Local Time
Gatwick ...	9.00 p.m.	—	Alexandria .	4.00 a.m.	6.00 a.m.
Alexandria...	5.45 a.m.	7.45 a.m.	Karachi ...	1.30 p.m.	6.00 p.m.
Karachi ...	3.15 p.m.	7.45 p.m.	Bombay ...	5.15 p.m.	9.45 p.m.
Bombay ...	5.45 p.m.	10.15 p.m.	Singapore ...	2.00 a.m.	9.00 a.m.
Singapore ...	4.00 a.m.	11.00 a.m.	Darwin ...	11.00 a.m.	7.30 p.m.
Darwin ...	1.00 p.m.	9.30 p.m.	Sydney ...	7.35 p.m.	5.35 a.m.
Sydney ...	9.00 p.m.	7.00 a.m.	Auckland ...	1.30 a.m.	1.00 p.m.

The total elapsed time for the journey Gatwick-Sydney (11,442 miles approximately) is 1 day 22 hours 35 minutes; Gatwick-Auckland (12,823 miles approximately), 2 days 4 hours 30 minutes. The overall speed, inclusive of intermediate stops, works out at 243.5 m.p.h. The total flying-time is 43 hours 5 minutes, and the time on the ground at intermediate stopping places is 9 hours 25 minutes.

Inter-stage Speeds

Average speeds over the various stages of the route may be of interest:—

TABLE IV

Gatwick–Alexandria	295.7 m.p.h.	(night)
Alexandria–Karachi	298.7 ,,	(day)
Karachi–Bombay	279.0 ,,	(evening)
Bombay–Singapore	296.1 ,,	(night)
Singapore–Darwin	298.8 ,,	(day)
Darwin–Sydney	298.3 ,,	(night)
Sydney–Auckland	297.7 ,,	(morning)
Overall average	296.67 ,,	

The reduction in speed over the short stage Karachi-Bombay (558 miles) is, of course, due to the lowering of the operational altitude from 28,000ft. to about 10,500ft. To average 279 m.p.h. it will be necessary to cruise at maximum economical speed. Over the last stage, Sydney-Auckland (1,340 miles), only 1,400 gallons of fuel and 98 gallons of oil will be required for a range of 2,400 miles, consequently the payload may be increased up to 32 passengers at 240 lb. and 4,500 lb. of mail and freight.

The time-table aforementioned could only be operated by a number of aircraft shuttling back and forth over one main stage of the route; for instance, a sleeper 'plane would operate over the first stage, Gatwick-Alexandria, making one flight of approximately seven hours' duration every 24 hours. A day 'plane would operate over the stages Alexandria-Karachi and Karachi-Bombay with accommodation for 32 passengers over the short stage. On certain of the intermediate stages, rapid change from day to night accommodation on the same aircraft may be necessary.

Only lengthy experience in operating aircraft in the upper troposphere can finally determine the mean velocity of the wind over a given section of the route. The time-table provides for continuous headwinds up to 40 m.p.h. over the entire route simply by reducing the time on the ground between stages, if necessary, to that required to trans-plane.

How fast could the Empire Express fly over the route Gatwick-Auckland? What is the minimum time? The publicity value of a purely record-making flight might well be worthy of serious attention. To prepare the machine for a sprint over the course would involve the removal of all furnishings from the cabin and the installation of extra fuel-tanks to bring the total fuel capacity up to 3,850 imperial gallons. The all-up weight in overload condition would be 65,000 lb., and the range at a mean cruising speed of 350 m.p.h. would now be around 6,000 miles, sufficient for a flight to Australia with only one intermediate stop, preferably at Bombay, and a non-stop flight from Darwin to Auckland. An analysis of a hypothetical record flight is given below:—

Stage	Mileages (approx.)	Flight Duration	Speed
Gatwick–Bombay ...	4,900	14 hr. 40 min.	335 m.p.h
Bombay–Darwin ...	4,500	13 hr. 25 min.	335 ,,
Darwin–Auckland ...	3,200	9 hr. 42 min.	330 ,,
	12,600	37 hr. 47 min.	

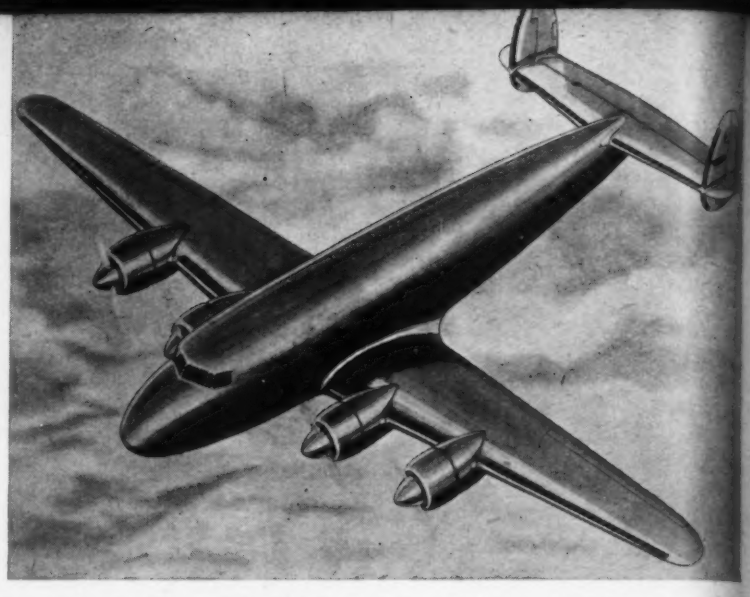
Allowing 1 hour 13 minutes on the ground for refuelling, we get the extraordinary time of 1 day 15 hours at an overall average speed of 323 m.p.h. A round-the-world flight could be completed in 3½ days.

Attracting Passengers

Not unnaturally, the Empire Air Express will not be everybody's idea of travel *de luxe*, despite the best efforts of decorative artists and furnishing experts to provide for the comfort and general sense of well-being of passengers. For some time after the inauguration of the service it is probable that only mail and freight would be carried, and then, perhaps, a few business men or Government officials on urgent matters. It might take a number of years to work up to a respectable passenger list for each flight. But the mere fact of it being possible to get a reply from a letter written to someone in Australasia *within a week* would alone justify such a service. Quite apart from mails, an increasing number of parcels will, in the future, go by air.

As already indicated, the frequency of service will be greater with medium-size air liners than with aerial colossi. With the former equipment, daily departures for the Antipodes are indicated, thus giving the travelling and corresponding public an impeccable service. With the

POST-WAR EMPIRE AIR SERVICE



A model of the Lockheed 144-14 Excalibur. Provision is for 36 passengers and a gross weight of 43,000 lb. The undercarriage is of the modern tricycle type.

service envisaged, I do not doubt but that the number of letters written will increase very substantially.

The possibility of a Great Britain-South Africa Air Express may now be considered. This route will not, of course, serve such large centres of population as the Australasian one, consequently the frequency of service will be reduced to two or three departures weekly. In the time-table given below it will be noted that the loss in working time is only one day for travellers to South Africa:—

TIME-TABLE II

Depart	G.M.T.	Local Time	Arrive	G.M.T.	Local Time
Gatwick ...	10.00 p.m.	—	Alexandria .	5.00 a.m.	7.00 a.m.
Alexandria ...	7.00 a.m.	9.00 a.m.	Kisumu ...	2.30 p.m.	5.00 p.m.
Kisumu ...	4.30 p.m.	7.00 p.m.	Mombasa ...	6.15 p.m.	8.45 p.m.
Mombasa ...	7.00 p.m.	9.30 p.m.	Capetown ..	4.00 a.m.	6.00 a.m.

The trans-Africa route is the ideal one for operating a high-speed two-way service, since both Egypt and the Union of South Africa are in the same time-zone with Kenya but half an hour fast of Egyptian time. By contrast, New Zealand time is 11½ hours ahead of Greenwich Mean Time.

Speeds over the trans-Africa section of the route are given below:—

Alexandria–Kisumu	293.3 m.p.h.	(day)
Kisumu–Mombasa	249.7 „	(evening)
Mombasa–Capetown	283.8 „	(night)

The total elapsed time of the route Gatwick-Capetown (7,261 miles approx.) is 1 day 6 hours and the speed, inclusive of intermediate stops, 242 m.p.h. Range over the last stage of the route is increased to more than 3,800 miles in still air by reducing the mean cruising speed to 300 m.p.h. Nairobi might well be used as an alternative stopping place to Kisumu on the Africa service.

Mention of Kisumu reminds me that the A.W. Atalanta class air liners are still based there. The Atalanta was described in *Flight* more than nine years ago (July 8th, 1932) and brought into service in 1933. The "A" is soon to give way to something much more potent, the Lockheed Lodestar. The still more potent Lockheed Constellation will be flying in 1942. Let's see how much progress can be made in a decade.

TABLE V

A DECADE (1932-33 to 1942-43) OF 4-ENGINED AIRLINER EVOLUTION

Make of Aircraft	A.W. "A" Class Atalanta	A.W. "E" Class Ensign	Boeing 307-B Stratoliner	Short 14/38	Lockheed Constellation
Engine type	Radial 2-row 10-cyl.	Radial 2-row 14-cyl.	Radial 1-row 9-cyl.	Radial 2-row 14-cyl.	Radial 2-row 18-cyl.
Supercharger type ..	1-speed	1-speed	2-speed	Exhaust-turbo	Exhaust-turbo
Cooling	Air	Air	Air	Air	Air
Maximum power (take-off) (b.h.p.) ...	4×375 1,400	4×935 3,740	4×1,100 4,400	4×1,600 6,400	4×2,500 10,000
Speeds, max. (m.p.h.)	155	205	250	310	350
Speeds, cruising(m.p.h.)	111	170	222	275	283
At height of (ft.) ..	—	7,000	19,000	25,000	27,500
Gross weight (lb.) ..	21,000	48,500	45,000	71,000	86,000
Payload (lb.) ..	1,850	8,000	8,000	7,500	—
No. of passengers ...	7–11	20–40	17–33	12–24	Up to 64
Wing area, gross(sq.ft.)	1,285	2,446	1,486	1,800	1,904*
Wing loading (lb./sq.ft.	16.3	19.8	30.3	39.4	45.06**
Power loading (lb./b.h.p.)	15.0	12.9	10.2	11.1	8.6
Range (miles) ...	640	860	1,200	3,370	4,000
Wing arrangement ...	High	High	Low	Mid	—

* ** Est. based on Consolidated 32 L.T. (Table I).

The fact that all five aeroplanes in Table 5 have air-cooled radial engines is interesting. One might have been forgiven for thinking that speeds of around six miles per minute for a large commercial transport would only have been practical with liquid-cooled in-line engines. However, the very great frontal area of the Wright engines with Dyna-focal mountings is more than compensated by the ability of these engines to maintain power up to very high altitudes. Over a ten-year period the power per cylinder of aero-engines has been more than doubled for a given volume. The most recent Wright cylinder develops nearly four times the power of the Serval cylinder:—

Serval cyl. (5in. ×5½in. 1⅞ litre)	37.5 b.h.p.	
Duplex „ (6¼in. ×6¼in. 3½ „)	138.8	„
S.E.E. „ (6in. ×5.4in. 2½ „)	125.0	„

In the hypothetical Super Empire Express 400 m.p.h. Air Liner, an increase in the number of cylinders permits of a considerable reduction of the engine stroke to produce the most compact possible design, without any serious loss in power.

The manner in which both speed and operational height have gone up and up is truly symbolic of man's striving down the ages—man's victory over space and time. I doubt whether the next decade, or any other decade, will ever see such advances as the one that is now drawing to a close. Let me conclude with a few extracts from Orville Wright's message to the world on his seventieth birthday:—

"Neither my brother Wilbur nor myself ever thought, when we took off in our plane all those years ago, that our invention would or could ever deal out so much destruction. That wasn't our idea at all!

"We always believed the aeroplane would be an instrument of peace, not destruction.

"The plane of to-morrow will make to-day's look like a horse and buggy. My hope is that it will be used to make people get closer and friendlier.

"We were given wings to get together with our fellowman, not to destroy him."

Super-spin

THE latest thing in world's records, it is reported, is claimed by a Canadian pilot, C. R. Patterson, of P. and H. Aircraft School, Toronto, who recently executed a spin of no fewer than 92 successive turns, starting from a height of 11,500ft. and pulling out at 2,300ft.

He noted, the report states, that he lost 4,700ft. during the first 40 turns but only 4,500ft. during the last 52 turns, which gives an average loss of exactly 100ft. per turn.

The machine was a Piper Cub, but, even allowing for this little machine's trifling wing-loading of 5.6 lb./sq. ft. and gross weight of 1,000lb., the figures given are rather surprising. But, if true, it seems a pity that, with another 2,300ft. to spare, Mr. Patterson didn't make it a round century!

His only reaction, we are told, was the illusion that the machine wasn't recovering properly during the pull-out, "thus again proving that one's sense can't be relied upon after a series of aerial gyrations." Anyone who has tried spinning "under the hood," of course, knows the temptation to disbelieve one's bank-and-turn indicator.

ave air-
ve been
iles per
ly have
lowever,
es with
ted by
to very
wer per
ed for a
levelops
:—

m.p.h.
permits
produce
ous loss

l height
striving
time. I
de, will
wing to
Orville
birth-

hought,
that our
ruction.

instru-

k like a
to make

fellow-

claimed
H. Air-
n of no
eight of

ring the
s, which

for this
ft. and
rprising.
ooft. to
!
that the
t, "thus
after a
spinning
to dis-

FIVE YEARS OLD

British Pioneer Work on Contra-rotating Airscrews : Flight Tests Early in 1940

ALTHOUGH it has been known that the Fairey Aviation Co., Ltd., has had under development for several years contra-rotating airscrews, it has not been possible to say much about this work until now. The external appearance of the airscrew will be familiar to many, for not only was a specimen exhibited at a Royal Aeronautical Society garden party at the Fairey aerodrome some years ago, but pictures of it have appeared in *Flight*.

It was very natural that Fairey's should be early in the field, for with that company's long and close association with Fleet Air Arm work the advantages of an airscrew which does not cause a "swing" were very obvious. There are several other advantages of contra-rotating airscrews, but as these were dealt with in *Flight* quite recently there is no necessity to repeat them here.

Five years ago the Fairey company began investigation and design of contra-rotating airscrews, under the direction of Capt. Forsyth. Manufacture was begun the following year, and a great deal of bench testing in the hangar was undertaken before the airscrew was put on an aircraft and tested in flight. The "teething troubles" associated with any mechanical innovation were largely overcome during this period, and by February, 1940, the airscrew was considered sufficiently reliable to be tested out in flight. Since then many service pilots and test pilots have flown behind the contra-rotating airscrew and the consensus of opinion seemed to be that in addition to the absence of swing, the rudder, elevator and ailerons were more positive in action than with the orthodox airscrew.

The Fairey airscrew is electrically operated by a single reversible electric motor. It is possible to constant-speed or stop the airscrew at any intermediate pitch. At the end of the pitch range a clever electrical device is incorporated for automatically off-switching the motor. This scheme has worked very satisfactorily.

The general operation is by means of gears. There is nothing complicated as the whole unit is so designed that production presents no problems. Another point of interest is that the front and intermediate gear boxes and the airscrews can be removed as complete units. Thus, from a servicing point of view the Fairey contra-rotating airscrews are as easy to handle as other types of airscrews now in use by the R.A.F. and Fleet Air Arm. The difficult problem of lubrication has been successfully solved, and designs are available for obtaining a rapid rate of pitch change, full feathering, and hydraulic operation as an alternative to electric.

The airscrew was originally intended for a type of engine still on the secret list, but designs are available to make it adaptable for Service types of engines. Provision is made for a cannon to be fitted through the shaft.

Nylon Parachutes?

IN testing Nylon fabric, a derivative of coal which is now used in stockings and toothbrushes to determine its suitability for use in parachutes, the U.S. Army Air Corps found that it stood exposure to sun, snow and rain better than silk, but was more susceptible to the effects of ultra-violet rays. The original strength of Nylon is greater than that of silk and it appears that Nylon is at least as good as silk for parachute manufacture.

American Salaries

SALARIES of some of the big executives of the American aircraft industry are listed in *American Aviation*. Converted to sterling at the rate of $4.03 to £1, these are:

J. H. Kindelberger, president of North American Aviation, £41,100; J. L. Attwood, vice-president, £19,500; J. S. Smithson, works manager, £7,200; Reuben H. Fleet, president of Consolidated, £8,900; I. M. Laddon, vice-president and chief engineer, £6,350; C. A. Van Dusen, vice-president and works manager, £5,550.

U.S. Aircraft Manufacture

GREAT BRITAIN had received about 3,500 military aircraft from U.S.A. since the start of the war up to May last, said Mr. John H. Jouett, president of the Aeronautical Chamber of Commerce. About another 3,500 have been delivered to the U.S.A. Army and Navy by the aircraft manufacturers who have total orders for 44,000 military craft. These will be distributed as follows: U.S. Army, 16,500; U.S. Navy, 8,500; Great Britain and Canada, 16,000; Knudsen Plan bombers, 3,600.

Women Aircraft Inspectors

INTERESTING jobs are open to women in the Aeronautical Inspection Directorate of the Ministry of Aircraft Production. These jobs are connected with the inspection and testing of various aircraft parts, including engines, wireless and electrical equipment, kites, balloons, parachutes, dinghies, etc. Candidates should be of not less than school certificate standard in physics or general science and mathematics, or have had reliable practical experience of engineering testing and inspection. Ability to read engineering drawings, interpret specifications, use micrometers and other measuring instruments is desirable. The age limits are normally 21 to 40 years.

The rate of pay for an Assistant Examiner is £2 17s. 6d. per week, plus Civil Service bonus of 7s. 6d., and overtime is payable. There are prospects of promotion to posts as Examiners at £220, plus bonus of £19 12s. per annum. Accepted candidates will be given a training course of one month with pay. Accommodation is available near the training school at approximately 30s. per week. Apply by postcard to Ministry of Labour and National Service, Employment Exchange (Room 24), 20, Nelson Street, Bristol, 1.

"Smoke Jumping"

THE U.S. Forest Service has been using parachutes in its campaign against fires since 1939. Forest rangers have been trained to jump with the 30ft. parachutes with steering flaps and widely-scalloped edges so that they may quickly reach a fire while it is still small enough to extinguish. After they are down small burlap parachutes are dropped with tools, food and a radio set. The jumper carries an emergency parachute in front of him as well as the standard one behind and on one leg is a coil of rope to lower himself out of any tree in which he may happen to land. His external clothing is a one-piece suit of very stout material and he is gloved and wire-masked.

U.S. Army Aircraft Designations

THE type letters and numbers of American aircraft will be less mystifying to readers if they realise that they indicate the Government specifications to which they are designed. Thus "P" stands for pursuit (or fighter); "B" for bomber; "PT" for primary trainer; "AT" for advanced trainer; "BC" for basic combat trainer; "O" for observation; "A" for attack bomber; "G" for autogyro. These letters are followed by a number which is the number of the specification; thus P-40 is the "fortieth pursuit specification." "X" in front of the letter indicates the experimental prototype, and "Y" is the first trial series. Letters "A," "B" or "C" after the figure are for variations of the specification. Translating "YO-5B" gives "first trial series to fifth observation aircraft specification; second variation of specification."

U.S. Navy Designations

THE Navy designations correspond closely to this system and "SB" stands for scout bomber (or dive bomber); "PB" for patrol bomber; and "F" for fleet fighter. But following the specification letter and number the Navy inserts a letter showing the constructing company. "A" is for Brewster, "B" for Boeing, "C" for Curtiss, "D" for Douglas, "F" for Grumman, "L" for Bell, "M" for Martin, "U" for Vought-Sikorsky and "Y" for Consolidated. Another difference in system is that the Navy uses figures for indicating the variations of the specifications. Thus "XF4F-3" indicates "prototype to fleet fighter specification Number 4; built by Grumman; third variation of the specification."

HERE AND THERE

Canadian Contract for the B-26

ACCORDING to the Department of Munitions and Supply at Ottawa, a $25,000,000 contract has been placed with National Steel Car, Ltd., for the construction of Martin B-26 bombers at their Malton (Toronto) factory. The contract cost excludes engines, airscrews and instruments. No date for the start of deliveries has yet been set.

Messerschmitt Me 115

ONE of Germany's new types which has not yet appeared in combat is the single-seater fighter, Me115. This machine is reported as having a wing span of 31ft., which is slightly less than the 32ft. 6in. of the Me109. Power plant is the more powerful Mercedes-Benz DB603, which is said to develop about 1,600 h.p., giving the fighter a speed of about 400 m.p.h.

"Going to it" in U.S.A.

LOCKHEED-VEGA, whose employees recently presented a Hudson to Coastal Command, are certainly "going to it."

The 28,930 employees of the affiliated companies are now on a 24-hour production schedule, no fewer than 10,722 of them being on night duty. The company is said to be hiring at the average rate of more than 2,500 a month—April reached a peak of 3,540 men hired—and some 8,000 employees are attending trade extension classes in the city schools of Burbank and nearby centres.

"Supercharged" Ignition Harness

REFERENCE to the special provision against the breakdown of insulation in the ignition system of high-altitude aircraft, which was made in the August 21st issue of *Flight*, has brought to light the fact that, as long ago as 1932, Mr. Georges Messier, of Rubery Owen Messier, Ltd., took out a patent for a "supercharged ignition system" of a very similar type to that now being developed in the United States, which it would appear to have anticipated.

The device consists, briefly, in enclosing the entire ignition system from the magneto to the plugs within a casing wherein normal atmospheric pressure at sea-level is maintained—hence the phrase, supercharged ignition harness.

Post-war Civil Flying

SIR FRANCIS SHELMERDINE, who will be 60 in October, is reported by *The Times* to be retiring from the post of Director-General of Civil Aviation very shortly. It is expected he will then head a committee to investigate the post-war problems of civil aviation, a task which is likely to prove as intricate as it is important.

Stalwart Fellows All

IT is with deep sadness that we on *Flight* salute the memory of P/O. Murray R. F. Baker, the youngest member of our Editorial staff. Baker was killed in action over enemy country during June, and is buried at Oldenburg, Germany. While he was with this journal he showed great promise, and we feel that he would eventually have become as well accredited aeronautically as was P/O. H. A. Taylor, who now spends his time testing military aeroplanes of all sorts, having given up a good position in the A.T.A. to do so.

Flt. Lt. H. F. King, whose articles on military aircraft and aircraft armament so intrigued and informed readers before the war, is now serving overseas. Other members of our Editorial staff who are serving include Lt. Cdr. (A.) C. R. Hodgson, R.N.V.R., and Flt. Lt. R. E. Casey, R.A.F.V.R., who were sub-editors; Flt. Lt. M. A. Smith, R.A.F.V.R., who is serving overseas; Sqn. Ldr. C. S. Watkinson, who was co-opted temporarily from *The Autocar*; A/C. L. Fish, on our staff of artists; and Mr. L. W. Maclaren, of our photographic staff, a lance bombardier in the R.A.

WOMEN WITH WINGS

AS chairman of the "Women with Wings" luncheon arranged by Mr. W. A. Foyle at Grosvenor House last week, the Minister of Air Production, Lt. Col. J. T. C. Moore-Brabazon, introducing the speakers, observed that Britain to-day, judged by carrying capacity, was building bigger and better bombers than any other country in the world, as well as fiercer and faster fighters. He was emphatic in his praise of the A.T.A. Service, which had done such great work and received so little publicity. Lord Sempill, one of the speakers, quoted the names of many women famous in aviation and in aircraft production circles, and observed that the A.T.A. possessed 450 pilots, 50 of them girls, and Miss Pauline Gower, Officer Commanding Women's Section, A.T.A., wanted 20 to 30 more. As to the record, 3,900 aircraft had been delivered to date, only one had been written off and 14 bent—an excellent record of service.

Miss Gower, responding, said that Col. Moore-Brabazon had always been their friend. When in January, 1940, the section started operations with Tiger Moths, she felt the implication of "the hand that rocks the cradle wrecks the crate." They were fortunate with the Tiger, a machine so easy to fly, but now there is no limitation upon types flown. She spoke in appreciation of her section, describing them as "a grand crowd." Feelingly she referred to the late Miss Amy Johnson, and testified to her thorough, conscientious work. Through the memorial scholarship (the funds of which are being invested in War Bonds) women may get their licences. She described the result of investigations into the accident that resulted in the death of Miss Johnson, and reaffirmed that she was alone in the plane. It was just incredibly bad luck that when Miss Johnson baled out—due possibly to icing conditions—she was over water.

Other speakers were Capt. Sir Malcolm Campbell and Mr. F. Handley Page.

Many well-known air personalities attended a luncheon at Grosvenor House on August 26th. The occasion was the "Women With Wings" Foyle's Luncheon. Left to right are seen: The Rt. Hon. J. T. C. Moore-Brabazon (Minister of Aircraft Production), Miss Pauline Gower (commanding the Women's Section of Air Transport Auxiliary), Admiral Mark Kerr, C.B., M.V.O., R.N., and Mr. and Mrs. F. Handley Page.

ROCKET PROPULSION—II.

A Means of Boost for Assisted Take-off, or Alternatively as a Brake

By F. W. LANCHESTER, LL.D., F.R.S.

(*Continued from p. 80, August 7th, 1941.*)

IN the preceding article, rocket propulsion under the condition of uniform flight velocity was discussed on lines similar to those adopted by the writer in the solution of the problems associated with exhaust efflux auxiliary.* In addition, a preliminary examination of the conditions of take-off was made. In the present article the latter subject will be further examined, and, following that, the possible use of the rocket in an inverse manner, i.e., for rapidly bringing the aircraft to a state of rest when landing will be investigated.

In comparison with the standard method of propulsion, the rocket leaves much to be desired. The rate of combustion not being under the direct control of the pilot, the rocket must be so proportioned as to give a recoil, a thrust, sufficient for horizontal flight and a margin beyond that. But if too great a thrust be provided, the range of flight, already short enough, will be still further diminished. On the other hand, the present system (propulsion by screw propeller) is far more flexible, as the thrust, under the direct control of the pilot, may be varied at will. As a consequence, the take-off "boost" in a rocket-propelled aircraft needs to be considerably greater because, unlike the screw propeller, the rocket can contribute no more than its economic thrust as adapted for horizontal flight.

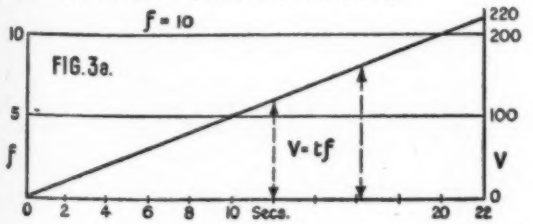
An Example

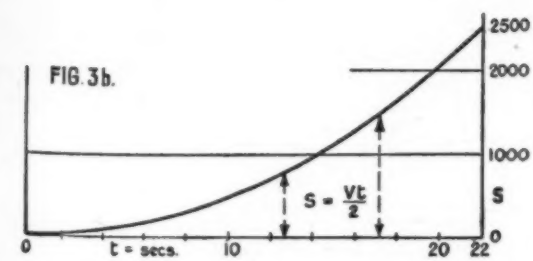
In order to illustrate this the following hypothetical example will serve, the data being the same as assumed in the article "Boost" in *Flight* of August 8th, 1940:—

Take-off speed, 150 m.p.h. = 220 ft./sec. = V.
Permissible length of run, 2,500ft.
Then, time of run, $t = 2\ S/V = 5{,}000/220 = 22.7$ seconds; and acceleration, f (assumed constant) $= V/t = 220/22.7$. Or allow $f = 10$ ft./sec. per sec.

To this must be added the rolling resistance and windage. Taken together these would not normally exceed 0.06 W, where W is the weight of the aircraft, equivalent to $f = 2$. At the outset the windage is zero, and 0.03 W or $f = 1$ would cover, but at the end of the run, when the machine is just leaving the ground, the rolling resistance is zero and the windage is just that of the aeroplane in free flight, and may be taken $= 0.07\ W$ or $f = 2.25$.

* See *Flight*, Nov. 16th and 23rd and Dec. 7th and 14th, 1939.





The writer thinks it is fair to assume that the propulsion rocket will contribute sufficient thrust to take charge of the rolling resistance and windage, and that the acceleration will need to be given by a take-off "boost," $f = 10$ ft./sec. per sec., or 0.3 W.

Now in Fig. 3a, the straight-line graph of constant ordinate value $f = 10$ when integrated gives the velocity V as a line of constant inclination, such that $V = 220$ at time $t = 22$. Then in Fig. 3b a graph is drawn giving the distance travelled, S, as a function of t, this being the integration of the velocity graph in Fig. 3a. Making use of the data pertaining to the rocket, namely v the efflux velocity = 6,000ft./sec. (as in the previous article) the rocket efficiency *during the period of acceleration* will be $V/v = 220/6{,}000 = 0.037$. The work expended in overcoming inertia, at thrust $= 0.3\ W \times 2{,}500$ ft./lb. $= 750\ W$ ft./lb., so that the propulsion work done by the rocket $= 750\ W/0.037 = 20{,}300\ W$ ft./lb. Taking the figure 566,000 ft./lb. available per lb. of rocket composition, the necessary weight of rocket composition will be $\frac{20{,}300\ W}{566{,}000} = 0.036\ W$. Or per ton weight (mass) $0.036 \times 2{,}240 = 81$ lb. of rocket composition necessary. In a previous article by the writer (*Flight*, August 8th, 1940) the figure 328 lb. was given for an aeroplane of ten tons weight, against 810 lb. as reached by the present computation. There are good reasons for this. (1) The *approach* in the previous article was different. (2) It was assumed that the rocket was to be applied to an aircraft driven normally by petrol engine and screw propeller. (3) In the present investigation use was made of amended, and probably more accurate, data.

The "Boost" Rocket

In the case of an aeroplane normally driven by recoil—i.e., by rocket propulsion—the rocket needed for "boost" would need to be far more powerful than that used for propulsion once the machine is in the air, although quite short-lived. The thrust necessary would be in the region of four or five times that needed for horizontal flight, but the duration (see Figs. 3a and 3b) would be less than half a minute.†

The addition of the supplementary rocket will not increase the flying weight, or result in any reduction in the range of flight, for by the time the plane leaves the ground the whole of the "boost fuel" will have been consumed, and the case or container may be jettisoned.

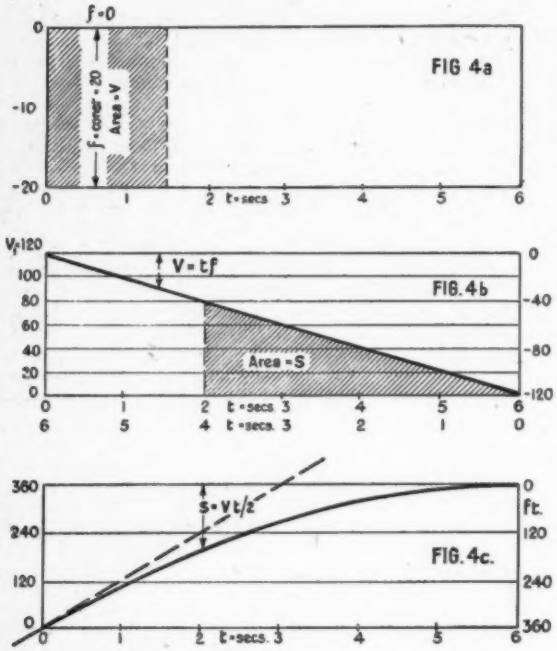
There are, of course, many practical problems to be dealt with and solved, especially as related to the rocket itself, but the writer would not expect these to prove insuperable, although in his estimate of energy output he may have been a trifle optimistic.

The writer believes it possible to make use of the rocket when making a forced or difficult landing. Little difficulty exists in making a perfect landing when the alighting ground is of sufficient area, and the surface is in good condition, even in the absence of a desirable wind. But when conditions are unfavourable, as when making a forced landing, as in a five-acre field with a none too good surface and partially obstructed or surrounded by trees, there is a demand for something more powerful than a wheel brake, such as, for example, a propeller that may be put into reverse. It might be found that one or more rockets *with efflux directed forward* would provide an alternative solution. It may be assumed that a "decelera-

† In a rocket-propelled machine the "boost" would need to be continued for some distance after contact with the ground is lost, that is until the altitude reached is sufficient to clear neighbouring obstacles, there being very little margin when compared with that available with propulsion by a supercharged engine and variable-pitch propeller.

ROCKET PROPULSION—II

tion" $f = -20$ would not be excessive, in addition to the ordinary brake effort. This would probably give a total equal to gravity, *i.e.*, -32.2 or thereabouts; the higher the better for the purpose intended.



Referring to Fig. 4a, the uniform acceleration due to the recoil of the rocket is taken $= -20$ ft./sec. per sec. as above. This, being negative, is measured downwards from the datum line Ox starting from the ordinate at t_0. Then in Fig. 4b the corresponding velocity graph is given; the velocity, prior to the point of time t_0, is taken $V_1 = 120$ ft./sec., and it falls at the rate of 20 ft./sec. per sec., becoming zero at the point of time t_2 after a lapse of six seconds. If the value of V had been zero at the point O, the velocity at t_2 would have been retrograde ($= tf$), but the ordinate OV_1 represents the *integration constant*. The velocity with which we are concerned is $V_1 - tf$, which means that the ground is the datum to which velocity is referred. In Fig. 4c the distance travelled during the time interval t_0, t_2, is denoted by S, and the graph is derived by integration of the velocity graph in Fig. 4b. That is to say, from point to point the ordinate in Fig. 4c is determined by the area shown shaded in Fig. 4b, being either calculated or measured by planimeter. Thus values of S from instant to instant are plotted in Fig. 4c, this being the method of graphic integration, and the distance 360ft. (scale on left hand) is the distance run before the plane comes to rest; this scale is repeated on the right of the figure with the zero at the end of the run. In the example plotted the assumption has been made that the deceleration (negative acceleration) is constant, and the values of t_2, V, and S are calculated at once from the law of the falling body, thus: Initial velocity taken = 120ft./sec.; f (const.) $= -20$. Hence time taken $t_2 = 120/20 = 6$ seconds, when V is zero. Then $S = Vt/2 = 120 \times 6/2 = 360$ feet. The reader will have little difficulty in tracing this out by the aid of the diagram, although the changes in the zero position are a little disconcerting. Perhaps it is easiest to think of the conditions as inverted, and the process as being one of acceleration from the point of rest as in the right-hand scale in Fig. 4c.

The Figs. 4a, 4b, and 4c represent the hypothetical case of an aircraft brought to rest by the action of the rocket alone, a constant applied force. But, under actual conditions, this would be a means to be reserved for emergency, and would be additional to the usual wheel brakes and windage and rolling resistance; so that, based on the data assumed, the total stopping effort would be little if anything short of that due to gravity, as though climbing a gradient having a slope of 45 deg.

Research Needed

There would be many practical difficulties to be overcome in connection with the applications of the rocket to aircraft, these centring mostly round the rocket itself and the rocket composition. The writer regards it as by no means certain that the figure for the kinetic energy in the efflux per lb. of rocket composition, i.e., 566,000 ft./lb., does not overstate the case; and in this there is an open field for experiment and research. Indeed, until this is settled and a figure based on actual experience has been established, the way is blocked to further progress. It would seem likely also that the fire risk, especially in the last application suggested, might prove an obstacle.

It is an open question whether there is any serious future for the rocket in its application to aircraft, and one on which the writer would not like to express an opinion one way or the other. For the general purposes of propulsion it would seem that the rocket is too severely handicapped by palpable limitations. The chief of these are: (1) That the range of flight is paltry in comparison with other methods. (2) That the thrust is not under the direct control of the pilot and cannot be made so. (3) The extent of the "take-off boost" necessary is very much greater than in an aircraft driven by engine and propeller. But *for the purpose of giving a boost to a propeller-driven machine the rocket may well have a future.*

Reference has been made to the fact that the expression V/v as the efficiency for an accelerated condition, founded on the work done being proportional to *time*, and the energy utilised as proportional to S (distance travelled), takes no account of the cumulative effect of loss of weight (mass), and that these expressions, therefore, are not exact. But where, as is always the case in practice, V is small compared to v, the resulting error is negligible, and the complication introduced in the treatment is great.

AIRCRAFT IDENTIFICATION CHARTS

ENORMOUS interest is being taken in the identification of aircraft, be it of friend or foe, by young and old, male and female, and in or out of uniform. Often it is a hobby as well as a duty, and prowess in recognition is thus a matter for pride.

The informative identification charts produced by *Flight* are extensively used by the Services and in Government circles, nearly 500,000 copies having been sold to the armed forces and the public. The following types are available from Iliffe and Sons Ltd., Dorset House, Stamford Street, London, S.E.1.

British Aircraft.—22½in. by 14½in., printed on card for hanging. 1s. net, by post 1s. 6d.

Pocket transparent chart—two celluloid cards eyeletted for ease of examination, 1s. 6d., post free.

American Aircraft used by R.A.F. and Fleet Air Arm.—22in. by 14½in., printed on card for hanging, 1s. 3d. net, by post 1s. 9d.

German Aircraft.—22½in. by 14½in., printed on card for hanging, 1s. 3d. net, by post 1s. 9d.

Pocket transparent chart—two celluloid cards eyeletted for ease of examination, 1s. 6d., post free.

Troop carriers, 12½in. by 10in., printed on card, folded for pocket, 6d. post free.

Italian Aircraft.—25in. by 17½in., printed on art paper, 6d. net, by post 7½d.

Correspondence

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters

EAR-WI-GO!

Insect with Retractable Wings

"INDICATOR" asks on August 21 if a biplane bird existed and you comment that you have seen tandem monoplane insects.

You have also seen countless biplane insects. The largest group of creatures, the coleoptera (beetles) are biplanes with a pair of folding gliding wings (elytra) and a pair of folding motor wings. The former, when closed, act as a shield for the latter, and when open are set at a fairly steep dihedral, allowing the roots of both pairs to lie closely together.

By the way, while the flight of birds has received a great deal of attention, that of insects might repay a closer study. Have you considered, for instance, the design and construction of an earwig's wing which folds up longitudinally and transversely like this letter? R. A. DENNE.

DRAWING OFFICE QUERY

Standard System Needed

ISN'T it possible for some sort of standard system to be arrived at for drawing modification?

At the present time two systems are in use—the Mod. Sheet and the inclusion of the Mod. in full at the edge of the drawing. Both types are usually laid down to suit a firm's fancy.

To find the "when and what" of an alteration to the actual component, one has either to wade through a series of Mod. sheets or read down a column of alterations, usually in microscopic print, until the correct one is found. My suggestion can be seen from the enclosed sketch which is shown for the R.H. top corner of drawing.

			7	6	5	4	3	2	1	DRG. ISSUE
				3		2			1	COMPT ISSUE
			703	514	379	218	49	18		MOD. Nº
			16.8.41	21.7.41	10.2.41	8.12.40	1.7.40	9.3.40		DATE
				30						AM. AMEND.
REF.	DESCRIPTION					DRG. Nº	PT Nº	WT OVER PORT	WT OVER STBD	WT OVER MAC.	REMARKS

The top line gives the drawing issues for *all* alterations, etc. The next line below gives the component issue, and this line brings out my point and is filled in only when the detail of the component is altered dimensionally or in design. The actual drawing issues of this type of alteration can be seen at a glance. The remaining lines explain themselves, but, if necessary, another line might be added for class of Modification.

Why should a component or an assembly be stamped, say, "issue 10" through the correction of a G.A. number, etc., on the drawing, when the actual part may never have been altered from issue 1? R. MARSH.

ASYMMETRICAL AIRCRAFT

A Not-so-Loppy Suggestion

MAY I suggest a variation of the "Loppy" aircraft, which you may or may not consider an improvement? Namely, a twin-engined aircraft with twin booms and twin tails and without centre nacelle. Structurally, such an aircraft would in theory be balanced and stable. The pilot's cockpit, however, has to be housed somewhere, and I suggest one of the booms be designed to give just sufficient room for the purpose. To restore the balance of drag between the booms, the other boom (which, for convenience, I will call number 2 boom) would have to be of approximately similar shape and proportions although not necessarily identical in design. It seems to me that, even taking into account the enlargement of the booms, the total drag of this "Loppy" variant would be less than that of the orthodox type.

The aircraft now, however, besides having room to spare in number 2 boom, would no longer be stable and would need to be balanced. This could be done in two ways. First, by putting most of the movable equipment, such as wireless set, camera, etc., in number 2 boom, and/or by placing the heaviest weight of fixed gun armament in the portions of the wing adjoining that boom. Or, secondly, by installing a multi-gun turret in number 2 boom. The first solution would be most appropriate where the greatest emphasis is on speed, as in the case of a strategical reconnaissance aircraft; and the second where equal emphasis is laid on defence, as in the case of a long-distance fighter. The field of fire of the turret would be slightly different from that of the turret in a Defiant, and appropriate tactics would have to be evolved.

It is worth noting that the booms would probably be big enough for the internal stowage of a largish bomb in each. These would, of course, have to be released simultaneously. I can imagine such an aircraft as this being suitable for high-speed "tip-and-run" bombing raids.

R.A.F. Club, W.1. JOHN W. JENNINGS.

CONTRA-PROPS

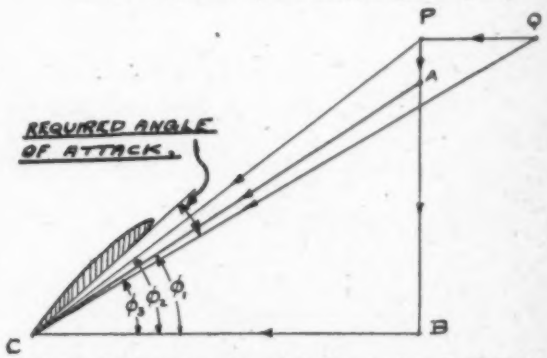
Angle of Rear Airscrew

IN your interesting article on contra-rotating airscrews in your August 21st issue you state that the rear blades are set at a slightly coarser angle than the front ones. This is incorrect, as the rear airscrew has to be set at a finer angle than the front one, in order that both airscrews shall absorb the same power at the same r.p.m. for any given condition of flight. The accompanying diagram indicates the reason for this requirement, which is predicted by theoretical calculations and has been verified by tunnel measurements. It results from the fact that the front airscrew imparts an axial velocity to the air and also a rotational one.

These two motions affect the rear airscrew in the sense that it is working at what amounts to a very slightly higher effective forward speed and an appreciably higher effective r.p.m. than the front one. However, while the former consideration tends to make a coarser pitch necessary for the rear airscrew, the latter consideration requires a finer pitch. It is the latter trend —i.e., the effect of the rotational velocity imparted to the air by the front screw—which is far more important, so that the net requirement is for a finer pitch on the rear airscrew.

De Havilland counter rotating airscrews will be set up in this way, and no doubt the Rotol airscrew is also.

(For the De Havilland Aircraft Co., Ltd.) A. V. CLEAVER,
Technical Assistant (Airscrews), Engineering Dept.



Explanatory diagram of the point made in the letter from De Havilland Airscrew Division

AB = Net forward velocity into rear screw neglecting effect of the front one.

BC = Net rotational velocity into rear screw neglecting the effect of the front one.

(Note that the triangle ABC would be approximately the same, if drawn for the front screw.)

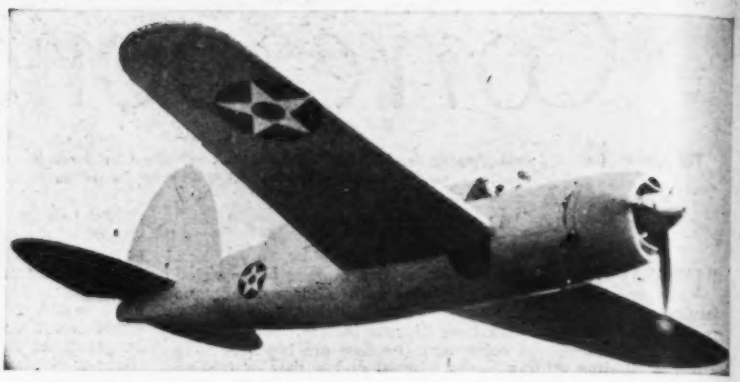
PA = Additional forward velocity into rear screw due to the front one.

QP = Additional rotational velocity into the rear screw due to the front one.

Net requirement is that the angle ϕ_1 is increased to ϕ_2 by PA, but is reduced to ϕ_3 by QP. ϕ_3 is less than ϕ_1.

Service Aviation

Royal Air Force and Fleet Air Arm News and Announcements



BREWSTER SB2A-1 : An almost identical model of this long-range dive-bomber is in production for Britain and the Nederlands Air Force. The bombs are stowed internally.

THE KING has been graciously pleased to approve the following awards for gallantry and devotion to duty in the execution of air operations:—

DISTINGUISHED SERVICE ORDER.

Wing Cdr. H. Rudolph GRAHAM, No. 7 Squadron.

Act. Wing Cdr L. V. E. ATKINSON, D.F.C., No. 82 Squadron.—In June, 1941, this officer carried out a low flying attack on the Tripoli Homs road, demolishing a large factory. The following day he led a most determined attack on shipping in Tripoli harbour. As a result a 20,000-ton liner and a 12,500-ton motor vessel were severely damaged, while the complete harbour organisation was disrupted; all the remaining ships sailed away later in the day.

Wing Cdr. Atkinson also led a successful attack on an aerodrome ten miles west of Tripoli, causing large fires and explosions. Amongst other damage inflicted, five aircraft were destroyed on the ground.

This officer has proved himself to be a fearless operational pilot, and has been responsible for the destruction of many thousands of tons of enemy shipping. He is a magnificent leader whose courage and determination have been of the highest order.

Act. Flt. Lt. Thomas John WATKINS, No. 82 Squadron.—In June, 1941, Flt. Lt. Watkins and Sgt. Sargent were pilot and observer respectively of an aircraft which participated in an attack on an enemy convoy off Lampadusa. Attacking a 6,000-ton merchant ship in the face of heavy anti-aircraft fire, Flt. Lt. Watkins was severely wounded in the legs during his run over the target. Nevertheless, he pressed home his attack, mast high, scoring hits on the objective. Enemy fighters then engaged his aircraft, but, by skilful manœuvring, he enabled his rear gunner to resist the attackers.

On the return journey Flt. Lt. Watkins fell into a stupor as a result of his wounds, and Sgt. Sargent, who was unable to call the air gunner as the inter-communication gear was out of order, removed the wounded pilot from his seat, took over the controls, and flew the aircraft back to base. During this period Flt. Lt. Watkins had momentary periods of consciousness, and, when informed that the aircraft was over base, insisted on taking control. Although in intense pain and very weak from loss of blood, by a supreme effort he regained his seat and made a landing without damaging the aircraft. Throughout Flt. Lt. Watkins displayed the highest courage and devotion to duty, while Sgt. Sargent displayed courage and resource in difficult circumstances.

BLAST IN THE MAKING : A sergeant wireless operator tries his hand at bomb filling during a visit to a Ministry of Supply factory.

BAR TO THE DISTINGUISHED FLYING CROSS.

Act. Flt. Lt. Richard Frewen MARTIN, D.F.C., No. 250 Squadron.

DISTINGUISHED FLYING CROSS.

The numbers after each name represent the squadron with which the recipient is serving.

Wing Cdr. Charles Victor HOWES, No. 102.
Wing Cdr. Richard Bowen JORDAN, No. 214.
Act. Wing Cdr. Kenneth Stewart BATCHELOR, R.A.F.O., No. 9.
Act. Sqn. Ldr. Alan Donald FRANK, R.A.F.O., No. 150.
Act. Sqn. Ldr. Stewart William Blacker MENAUL, No. 15.
Act. Sqn. Ldr. George Roger TENCH, R.A.F.O., No. 49.
Act. Sqn. Ldr. Stewart Owen TUDOR, R.A.F.O., No. 106.
Flt. Lt. Henry Gilbert FLETCHER, No. 6.
Flt. Lt. Charles Horace FRY, No. 112.
Flt. Lt. Alan Clement GODFREY, No. 211.
Act. Flt. Lt. Homer Powell COCHRANE, No. 112.
Act. Flt. Lt. William Michael COLLINS, No. 82.
Act. Flt. Lt. Keith Henry Augustus ELLIS, No. 66.
Act. Flt. Lt. Eric George FRANKLIN, R.A.F.V.R., No. 35.
Act. Flt. Lt. Douglas David HAIG, No. 144.
Act. Flt. Lt. Richard Anthony LEWIS, No. 29.
Act. Flt. Lt. Alfred John OGILVIE, No. 58.
Act. Flt. Lt. Walter Ronald Nisbet STURDY, No. 214.
Act. Flt. Lt. James Leslie William WAGLAND, R.A.F.V.R., No. 78.
F/O. Rayner BAKER, R.A.F.V.R., No. 44.
F/O. William Henry HILL, No. 50.
F/O. Ross JAMES, No. 102.
F/O. Ernest Charles LANE-SANSAM, No. 203.
F/O. William Maurice LEWIS, No. 39.
F/O. Daniel MCINTOSH, No. 9.
F/O. Robert Ross STEPHENSON, No. 208.
F/O. Ranulf TREVOR-ROPER, No. 84.
F/O. Alfred Denys WEBB, No. 78.
Act. F/O. Archibald George Alexander COCHRANE, No. 15.
Act. F/O. William Abbotson TETLEY, R.A.F.V.R., No. 35.
P/O. Richard James BOLLARD (N.Z.), R.N.Z.A.F., No. 149.
P/O. Douglas Frank Kitchener EDGHILL, No. 229.
P/O. Philip Bennett MOORE, No. 50.
P/O. Peter George Hooke PEARSON, A.A.F., No. 77.
P/O. Cyril Leslie TRICKETT, No. 44.
W/O. Thomas Charles MORRIS, No. 274.
Sqn. Ldr. Oswald James Milman BARROW, No. 220.
Flt. Lt. Jack Albert HOLMES, No. 240.
Act. Flt. Lt. Richard John VAUGHAN, No. 201.
F/O. Stanley George BAGGOTT, No. 95.
Flt. Lt. Henry Niel George WHEELER.

Flt. Lt. C. S. BARTLETT, No. 216 Squadron.—One night in May, 1941, this official carried out a flight which necessitated transporting a party of Royal Engineers and landing them beside a highly strategical railway bridge which it was intended to destroy. Much of the complete success of this daring and difficult operation can be attributed to the skill displayed by this officer. Flt. Lt. Bartlett has also executed eleven successful night raids.

Act. Flt. Lt. W. A. SHILLITTO, No. 75 (S) Wing.—This officer has carried out many flights of a technical nature in which he has shown great devotion to duty. On one occasion his aircraft was repeatedly attacked by a Messerschmitt 109F. After taking successful avoiding action, Flt. Lt. Shillitto succeeded in firing a long burst which damaged the Messerschmitt and the engagement was broken off. Flt. Lt. Shillitto is a capable leader who has set a very high standard.

F/O. C. S. DAVIS, R.A.F.V.R., No. 33 Squadron.—One night in June, 1941, this officer carried out a successful attack on a target at Benghazi, afterwards flying on to Binina, where, in spite of heavy anti-aircraft fire, he machine-gunned aircraft on the ground from a low altitude. This officer has carried out 34 operational flights, and has at all times displayed exceptional keenness, skill and determination.

F/O. L. D. M. SCOTT, No. 145 Squadron.—F/O. Scott has taken part in 32 sweeps over enemy territory and has displayed the utmost gallantry and unfailing cheerfulness throughout. He has destroyed two enemy aircraft.

Act. Sqdn. Ldr. V. B. VERITY, No. 96 Squadron.—Sqn. Ldr. Verity has shown a fine example by the skill with which he has intercepted enemy aircraft at night and the determination he has displayed in his attacks. He has destroyed at least two and damaged two other hostile aircraft. In most of his combats Sqn. Ldr. Verity has been accompanied by Sgt. Wake, who, as an air gunner, has displayed great skill, determination and courage.

Act. F/O. G. E. WALKER, R.A.F.V.R., No. 7 Squadron.—In July, 1941, F/O. Walker and Sgt. Capel were navigator-bomb aimer and rear gunner respectively of an aircraft which attacked the battle cruiser *Scharnhorst* at La. Pallice. F/O. Walker skilfully navigated the aircraft to the target, and, in the face of intense anti-aircraft opposition, succeeded in scoring a direct hit on the battle cruiser with a heavy bomb.

During the operation the aircraft was engaged by six enemy fighters, and Sgt. Capel, by accurate and well-controlled fire, destroyed the first two of them which attempted to close the range. The remainder finally flew away.

F/O. Walker by his navigational and bombing skill contributed largely to the success of the operation, while Sgt. Capel displayed great coolness and accurate shooting when opposed by a superior number of enemy aircraft. Both have participated in many previous operational missions.

BAR TO THE DISTINGUISHED FLYING MEDAL.

Sgt. J. ONIONS, D.F.M., No. 226 Squadron.—This airman has completed 186 sorties. In July, 1941, he was pilot of one of a formation of aircraft which carried out a low-level attack on a convoy in daylight off the coast of Nordeney. On sighting the convoy of seven merchant vessels escorted by Flak ships, the formation broke up and the pilots attacked individually. In the face of intense anti-aircraft fire, Sgt. Onions secured at least one direct hit from low level on a ship of about 3,000 tons. His aircraft was twice hit; two of his crew received injuries, the navigation instruments and maps were wrecked, and the hydraulic system was put out of action.

Despite all this, Sgt. Onions successfully led the formation back to base and landed his damaged aircraft, with its undercarriage retracted, without further injury to his crew. He has at all times displayed high courage and determination.

DISTINGUISHED FLYING MEDAL.

Flt. Sgt. George Edward BAILEY, No. 34.
Flt. Sgt. Robert BITHELL.
Flt. Sgt. Philip Douglas CHERRY, No. 55.
Flt. Sgt. William Henry DUNWOODIE, No. 94.
Flt. Sgt. Michael Gregory GARDINER, No. 7.
Flt. Sgt. Alfred William GROVES, No. 107.
Flt. Sgt. James Wesley HOUSTON, No. 83.
Flt. Sgt. Robert Douglas LEWIS, No. 203.
Flt. Sgt. John Charles MACGREGOR, No. 44.
Flt. Sgt. John Roy MARSHALL, No. 211.
Sgt. Frederick Alan ABBOTT, No. 205.
Sgt. Sydney Rupert ANDREWS, R.A.F.V.R., No. 99.
Sgt. John Clifford BANKS, No. 102.
Sgt. John David BAXTER, R.A.F.V.R., No. 149.
Sgt. Frank BELL, No. 58.
Sgt. Francis James Thomas BROOKS, No. 11.
Sgt. Donald Roy Highfield BROWN, No. 218.
Sgt. Frederick Raymond BROWN, No. 144.
Sgt. Ian Crawford BURNS, R.A.F.V.R., No. 144.
Sgt. Charles Edward CASBOLT, No. 90.
Sgt. Maurice William CHADWICK, No. 78.
Sgt. Ralph Edward CLARK, R.A.F.V.R., No. 144.
Sgt. Stanley Joseph COLEMAN, A.A.F., No. 58.
Sgt. Douglas Henry CROCKER, R.A.F.V.R., No. 51.
Sgt. William Rupert CROFTS, No. 214.
Sgt. Peter Bruce DENNIS, R.A.F.V.R., No. 211.

Sgt. Alexander DENOVAN, No. 49.
Sgt. John Edward Anthony Harrington FAIRFAX, R.A.F.V.R., No. 9.
Sgt. Edward James FREEMAN, No. 83.
Sgt. Edward Douglas GALLAGHER, R.A.F.V.R., No. 51.
Sgt. John George GALLEY, R.A.F.V.R., No. 15.
Sgt. George Henry Ford Goodwin GREGORY, R.A.F.V.R., No. 44.
Sgt. Frederick George HOLLOWAY, R.A.F.V.R., No. 99.
Sgt. Thomas Colin IMRIE, No. 51.
Sgt. Percy John Nevell LAMB, R.A.F.V.R., No. 49.
Sgt. Eddie LEAVESLEY, No. 50.
Sgt. Alastair Macnab McKELVIE, No. 144.
Sgt. Albert MARKLAND, No. 78.
Sgt. Percy Cyril MORGAN, R.A.F.V.R., No. 58.
Sgt. Edward Patrick NOLAN, No. 78.
Sgt. Leonard Robert PAGE, No. 211.
Sgt. Frank Desmond ROUND, No. 84.
Sgt. William SHIMMIN, No. 211.
Sgt. Sidney William SILLS, No. 39.
Sgt. James SIMPSON, No. 58.
Sgt. Robert Cecil SMYLIE, R.A.F.V.R., No. 89.
Sgt. Joseph TINSLEY, No. 51.
Sgt. Julian Robert WANBON, No. 51.
Sgt. Jesse Bowdler WILSON, R.A.F.V.R., No. 51.
A/C. James Verdon WATERLAND, No. 230.
Flt. Sgt. Terence Nightingale STAPLES, R.A.F.V.R., No. 114.
Sgt. George Robert HEPPELL, R.A.F.V.R., No. 220.
Sgt. George McELROY, No. 114.
Sgt. Ralph Edward WALKER, R.A.F.V.R.
Sgt. John Ronald WELLS, No. 201.
Sgt. Peter David ADAMS (deceased).
Sgt. Jack BALDWIN (deceased).
Sgt. Jack GIBBS (deceased).
Sgt. Robert Edward NICHOLSON.
Sgt. John Robert Graham LAMB (deceased).
Sgt. J. S. SARGENT, No. 82 Squadron.—For citation see Flt. Lt. Watkins, D.S.O.
Sgt. Frederick William WAKE, No. 96 Squadron.—For citation see Sqn. Ldr. Verity, D.F.C.
Sgt. Bernard CAPEL, No. 7 Squadron.—For citation see Act. F/O. Walker, D.F.C.

Sgt. V. G. HUDSON, R.A.F.V.R., No. 11 Squadron.—This airman has carried out 15 operational flights in the Albanian, Syrian and Greek theatres of war. On one occasion, whilst attacking the outer defences at Kiswe, his aircraft was considerably damaged by anti-aircraft fire, but with great skill Sgt. Hudson succeeded in flying back to base and landing safely.

On another occasion he displayed great initiative while carrying out a flight to Larissa. Although attacked by an enemy fighter and encountering other difficulties, he successfully completed his mission. In April, 1941, whilst engaged in ferrying duties, Sgt. Hudson's aircraft was attacked by four Italian fighters. He eventually succeeded in shaking them off, but later was compelled to alight on the sea owing to engine trouble. He was picked up by a passing enemy ammunition ship, which was heavily bombed, but before it exploded Sgt. Hudson swam ashore and, although machine gunned whilst in the water, succeeded in making contact with our own forces. Throughout, this airman has displayed great skill and courage.

D.H. AIR AMBULANCE : An interior view of one of the De Havilland Rapide air ambulances supplied by the Silver Thimble Fund.

Sgt. G. H. MOORE, No. 148 Squadron.—One night in June, 1941, this airman was the rear gunner of an aircraft which attacked a target at Benghazi. During the run up, the aircraft was engaged by three Italian fighters, one of which was shot down and the other two driven off by the determined and accurate shooting of Sgt. Moore. Altogether, this airman has completed 46 operational flights and has at all times displayed great courage and a high standard of gunnery.

Sgt. J. C. SAICH and St. L. SMITTEN, R.A.F., both of No. 9 Squadron.—Sgts. Saich and Smitten were captain and navigator of an aircraft engaged in an attack on a target at Bremen one night in July. When over Bremen, the aircraft was caught and held by a large concentration of searchlights and immediately subjected to most intense and accurate fire from the ground defences. One shell burst, wounded the rear gunner and cut the hydraulic controls of the turret, and a second set fire to the fabric of the fuselage. In a few seconds the fire spread backwards to the tail fin.

Sgt. Smitten endeavoured to reach the rear gunner, but, being driven back by the fire, he attacked it with an extinguisher and successfully subdued it. He then succeeded, with difficulty, in releasing the injured rear gunner, who was trapped in his damaged turret.

During this time another shell splinter ignited the forced landing flares in the port mainplane, but those burnt through and fell away from the aircraft. Despite all these hazards, Sgt. Saich successfully extricated his aircraft from this area and set course for home. In spite of the damage sustained, he succeeded, with the skilful navigation of Sgt. Smitten, in reaching the shores of this country, where he made a forced landing without further injury to the crew. Both airmen displayed great courage, coolness and determination

THE King has been graciously pleased to approve the award of the British Empire Medal (Military Division) to the undermentioned airman :—

Act. Sgt. N. E. LANNING, R.A.F.V.R.—This airman was on duty at a railway station, in a town which was heavily attacked by enemy aircraft on two successive nights in December, 1940. Sgt. Lanning worked unremittingly to minimise damage by incendiaries and to find and rescue injured persons, bringing them to the station first aid post for attention. He was conspicuous for his efficiency in all directions and showed an immediate grasp of quickly changing events. His gallantry, calm demeanour, good humour and tireless energy contributed greatly towards the maintenance of good spirits and order amongst the other Railway Transport Office staff and the public generally.

BLITZ TAMER : Milo Burcham, Lockheed test pilot, climbing from a production Lockheed Lightning after a test flight.

Roll of Honour

Air Ministry Casualty Communique No. 78.

THE Air Ministry regrets to announce the following casualties on various dates. The next-of-kin have been informed.

KILLED IN ACTION (WHILE FLYING IN OPERATIONS AGAINST THE ENEMY).—Sgt. P. G. Bolton; Sgt. J. A. Broadway; Sgt. W. L. Butler; Sgt. W. Chambers; Sgt. L. F. Clay; P/O. G. A. L. Crabb; L.A/C. L. W. Daniell; Sgt. W. Forster; Flt. Sgt. R. J. W. Geater; Sgt. A. H Gregory; Sgt. V. H. Leng; Flt. Sgt. W. G. Lewis; Sgt. J. D. McCracken; Sgt. D. A. Price; Sgt. W. J. Q. Ramsay; P/O. E. A. Scott; L.A/C. R. S. Smith; Sgt. D. P Thomas; Sgt. E. O. Townsend; Sqn. Ldr. R. G. Weighill; Sgt. C. C. Woodward; Sgt. A. J. Worsfield.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. B. P. Hall; Sgt. J. W. Hammond; Sgt. W. L. Smith.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. K. R. Allen; Sgt. N. O. Allen; Sgt. J. S. Beattie; Sgt. T. F Behan; Sgt. D. Brand; P/O. G. H Brooks; Sgt. J. E Brown; Sgt. J. Burton; Sgt. J. W. Chamberlain; Sgt. W Chambers; P/O. C. D. Chapman; P/O. D. L. Clarke; Sgt. J. Coates; F/O. D. C. F. Coutts; Sgt. T. J. Crawley; Sgt. B. Drake; Sgt. R. F. J. Duncan; Sgt. E. J. Egan; Sgt. R. W. Fairlamb; Flt. Lt. J. R. Fishwick; F/O. R. L. Glyde, D.F.C.; Sgt. A. Gowling-Scones; P/O M. P. Griffiths; Sgt. A. R. Grindley; Sgt. R. F Henry; Sgt. D. V. House; Sgt. A. C Johnston; P/O. J. C. Kirkpatrick; P/O. J. L. Leeds; Sgt. W. R. J. Little; Sgt. R. C. McCracken; F/O. R. T. Mulligan; F/O. L. D. P. Murphy; P/O. W. E. Peers; P/O. A. W. Poulsen; Sgt. J. W. Pratt; Flt. Lt. J. A. Richardson; P/O. F. A. Roach;

SERVICE AVIATION

Sgt. J. Rowlands; P/O. P. G. H. Salmon; Sgt. B. Sheldrick; Sgt. H. P. Shipley; Sgt. C. E. R. Sidebotham; Sgt. A. T. Smith; Sgt. K. H. Smith; Sgt. W. Steele; P/O. P. J. Strong; Sgt. H. Summers; P/O. C. L. Tibbitts; P/O. P. C. Traill-Smith; Sgt. D. Trigwell; Sgt. T. Wareing; Sgt. K. L. Watson; Sgt. A. G. S. White; Sgt. H. L. Williams; Sgt. C. E. R. Yard; Sgt. R. W. Yarwood; Sgt. L. A. Young.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Act. Flt. Lt., Sir R. A. MacRobert, Bart.

WOUNDED OR INJURED IN ACTION.—Sgt. J. D. Armstrong; Act. Sqn. Ldr. J. W. Bodman; Flt. Lt. H. de G. Domville; Flt. Lt. T. A. F. Elsdon, D.F.C. Sgt. J. J. Hughes; Sgt. F. J. B. Twistelton; Sgt. W. Walker; Sgt. L. T. Wilton-Jones.

PREVIOUSLY REPORTED MISSING, NOW REPORTED WOUNDED OR INJURED IN ACTION.—P/O. T. Livingstone.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Sgt. R. E. Carter; Sgt. H. Dearnley; Sgt. T. F. Ebrill; Sgt. B. R. Harrington; Sgt. J. Nicholl; Sgt. W. H. Sargent.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. R. S. Adair; Sgt. J. Austin; Sgt. G. A. Avory; Sgt. G. H. Barnard; Sgt. B. W. F. Bates; Sgt. C. G. Blandon; Sgt. W. M. Caine; F/O. G. C. Conpan; Sgt. J. L. Cullum; Sgt. G. E. Davies; P/O. J. R. L. Dunn; P/O. P. B. G. Edwards; Sgt. R. G. G. Fairweather; Sgt. J. F. Hollingworth; Sgt. A. Jepson; P/O. G. M. Kennedy; Act. Sqn. Ldr. W. C. McArthur; Sgt. S. R. Mayor; P/O. R. R. Price; P/O. W. K. Stobbs; Sgt. A. T. Thomas

MISSING.—Sgt. R. W. Adamson; Sgt. R. I. H. Aird; A/C.2 A. R. M. Anderson; P/O. P. G. Anderson; A/C.1 J. A. Auckland; A/C.2 L. J. Austin; A/C.2 C. P. Bailey; Sgt. P. D. Baker; Sgt. J. E. Balch; Flt. Sgt. F. Barker; Sgt. N. Baron, D.F.M.; Act. Flt. Lt. R. B. Barr; A/C.2 J. H. Bateman; Sgt. G. J. Beckwith; Sgt. C. S. Beresford; Sgt. A. H. Bird; Sgt. S. E. Bird; Flt. Sgt. G. E. Bolam; Sgt. W. C. K. Bounds; Sgt. B. A. J. Boyse; A/C.1 J. P. Brand; Sgt. P. C. Brewer; Sgt. S. Bridges; L.A/C. H. Broadhurst; Sgt. J. S. Bucknole; A/C.2 R. Butler; Sgt. S. S. Carlile; A/C.2 A. G. Carr; L.A/C. D. Carr; A/C.2 J. F. Carr; L.A/C. E. D. Chapman; Cpl. E. Chapman; Sgt. W. J. Clarke; Cpl. D. J. Close; A/C.2 F. Clough; Sgt. P. Conlon; A/C.2 E. Connock; Sgt. N. W. Cook; A/C.2 R. D. Coombes; Sgt. A. B. Cooper; Sgt. J. J. Cox; Sgt. R. Critchley; A/C.1 R. P. Croft; Sgt. H. D. Cue; P/O. J. S. Curl; Cpl. N. Daren; A/C.2 R. Dennison; Sgt. E. G. J. Dewin; A/C.1 N. Dickinson; A/C.2 J. E. Donnelly; L.A/C. R. V. P. Drower; Sgt. G. A. Dverjetz; A/C.1 A. T. Egan; P/O. E. C. Elder; A/C.1 K. A. Elliott; Sgt. H. T. Ellis; P/O. L. F. Evans; A/C.1 J. T. Farquhar; A/C.2 F. K. Faulkner; A/C.1 B. A. MacG. Fergusson; L.A/C. G. F. Foulger; Sgt. E. Fox; P/O. R. T. Franklin; F/O. C. V. Fraser, D.F.C.; Sgt. N. J. Gibling; P/O. K. F. Glock; Sgt. P. W. Goodwin; P/O. R. Gouldinz; A/C.1 D. J. R. B. Gray; P/O. W. G. Green; A/C.2 K. W. Gregory; Sgt. P. M. Griffin; A/C.2 L. R. Hambidge; A/C.2 J. K. Hammond; Sgt. A. W. Handley; Sgt. W. L. Harding; L.A/C. C. F. Harrison; A.C.1 A. Heath; L.A/C. H. E. Hey; L.A/C. N. Hill; Sgt. J. Hoban; A/C.2 C. Holland; Grp. Capt. E. J. L. Hope, A.F.C.; Sgt. K. W. Hopkinson; P/O. D. W. Horrocks; Act. Sqn. Ldr. W. Hughes; Sgt. J. Hunter; Sgt. L. R. Hutson; P/O. D. H. M. Jack; Sgt. W. K. Jenkins; A/C.2 S. J. Jerome; A/C.2 S. Jones; A.C.2 E. B. Jordan; Sgt. R. H. Jordan; A/C.1 M. Joseph; P/O. N. H. C. Keable; Cpl. C. Kenward; Sgt. S. G. Kybird; P/O. R. G. Lauder; Cpl. R. C. Lawson; P/O. J. T. Leacock; Sgt. A. J. Le Poidevin; Flt.Sgt. J. N. Lister; Flt. Lt., E. S. Lock; D.S.O., D.F.C.; Sgt. F. Lowrey; A/C.2 J. T. McCarthy; Sggt L. P. MacDowell; A/C.2 R. P. McGregor; A/C.1 A. McKinney; A/C.2 W. J. McLean; P/O. J. Mares; A/C.1 F. H. Marsh; F/O. K. J. Masters; A/C.1 J. H. Masterton; A/C.2 G G. Medland; A/C.1 B. J. Messer; Sgt. K. B. Minty; A/C.1 W. J. Mitchell; L.A/C. G. H. Nickells; P/O. L. B. O'Reilly; Sgt. A. E. Owen; Sgt. L. C. Page; A/C.1 H. Painley; Sgt. L. R. Palmer; Sgt. D. Parkin; Act. Wing Cdr. T. N. Partridge; Sgt. V. S. Payne; Sgt. I. E. Pearce; A/C.1 D. H. J. Peppercorn; Sgt. R. G. W. Perkins; Sgt. D. M. Philip; Sgt. C. D. Phillips; Cpl. F. C. Pittaway; Sgt. A. Pont; A/C.2 F. A. Popejor; Sgt. F. J. E. Price; Sgt. C. C. Proctor; Sgt. R. M. Ramsden; Sgt. E. J. J. Raper; Sgt. E. H. Rogers; A/C.1 F. B. Rose; A/C.1 R. C. Rothwell; Sgt. A. S. Rowan; Act. Sqn. Ldr. A. A. MacD Scott; Sgt. O. J. Shadbolt; P/O. R. Shaw; P/O. P. G. Shillitoe; A/C.1 E. Shipman; L.A/C. M. Singleton; Flt. Sgt. J. O. N. Smith, D.F.M.; A/C.2 W. H. Smith; A/C.2 H. A. Snell; P/O. B. W. B. Squires; F/O. J. R. G. Sutton; A/C.1 J. Swadling; Sgt. G. W. Tabor; Flt. Lt. K. W. Tait, D.F.C.; Sgt. F. B. Tipper; A/C.2 D. E. Turner; A/C.2 W. P. Turner; Sgt. R. W. Ullmer, D.F.M.; Sgt. S. H. Vinter; Sgt. P. J. Walder; Sgt. F. G. Walker; P/O. J. H. Walls; Act. Flt. Lt. H. Waples; A/C.2 H. Waterhouse; A/C.1 W. G. Webster; Sgt. R. J. S. Wicks; Sgt. J. E. Wiggall; Sgt. W. Wilcox; Sgt. M. Wilding; Sgt. R. P. Williams; Sgt. K. R. Wood.

PREVIOUSLY REPORTED PRISONER OF WAR, NOW REPORTED MISSING.—Sgt. C. L. Hand; Sgt. O. A. Hutchinson; Sgt. O. J. S. Poole.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE (WHILE ENGAGED ON NON-OPERATIONAL FLYING DUTIES OR ON THE GROUND THROUGH ENEMY ACTION).—F/O. C. T. Dacombe; L.A/C. R. Daly; Sgt. T. V. Davies; Sgt. C. J. Dixon; Sgt. D. C. Haynes; Sgt. A. R. Jones; Sgt. H. B. K. Moss; Sgt. W. B. Oakes; Act. Flt. Lt. W. T. D. Windham.

KILLED ON ACTIVE SERVICE.—Flt. Lt. D. Bamford; P/O. D. M. Batley; Sgt. E. B. Beattie; L.A/C. R. Blake; Sgt. E. R. Bousfield; Sgt. J. E. S. Burke; P/O. J. W. Carr; P/O. P. A. Christian; L.A/C. W. B. Christie; Sgt. J. A. Coleman; Flt. Lt. J. Compton; Wing Cdr. A. H. Dalton; Sgt. G. D. Davies; Sgt. G. L. A. Dawson; Flt. Lt. A. C. Dier; L.A/C. S. A. Downing; P/O. W. R. Driver; Sgt. S. H. V. Durrell; A/C.1 R. Fearnley; L.A/C. R. E. Fellows; A/C.2 E. A. Fidell; Cpl J. H. W. Fogden; L.A/C. I. S. Forbes; A/C.2 R. Forman; Sgt. E. C. Graham; Sgt. C. F. Greig; L.A/C. T. W. Gurnell; Sgt. J. Hastings; L.A/C. H. R. Hearne; P/O. E. H. Henson; Act. Sqn. Ldr. P. S. Hutchinson; L.A/C. W. W. Hutchinson; Cpl. T. S. Jones; L.A/C. C. A. Kew; P/O. W. H. King; L.A/C. L. L. Kingston; Cpl. J. C. Kinniard; L.A/C. G. Laing-Meason; Sgt. R. E. Lea; P/O. G. P. Mandeville; F/O. O. V. Morrogh-Ryan; Sgt. P. E. Neale; L.A/C. M. E. Oughton; Sgt. J. H. Overy; P/O. E. R. Pinches; A/C.1 H. L. Reed; A/C.2 P. S. Rivington; Flt. Lt. H. Speke; P/O. G. F. Talent; P/O. K. S. Taylor; P/O. G. R. Timewell; Sgt. J. H. Tittley; Flt. Lt. M. W. H. Uphill; Flt. Lt. P. Walker; Sgt. J. O'N. Walshe; A/C.2 J. A. H. Watson; Sgt. H. R. Wyratt; Sgt. E. R. Willis; Sgt. G. K. Wood; Sgt. G. T. Yates; L.A/C. E. C. Yeates.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—L.A/C. A. J. Donaghy; Cpl. J. G. Gavins; Cpl. S. Mills; L.A/C. G. Swift.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Wing Cdr. M. W. L. LeV. Baker; L.A/C. C. Berry; Sgt. L. R. Burgin; A/C.2 C. A. Case; L.A/C. J. Cunningham; Act. Flt. Lt. R. C. Graham; A/C.1 R. Hepworth; Sgt. A. Hills; A/C.1 J. R. Hulton; A/C.1 J. T. Humphrey; F/O. J. E. Jordan; L.A/C. L. H. Maxwell; Sgt. J. B. Radfels, D.F.M.; P/O. G. D. W. Rogers; A/C.1 S. Waring.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Sgt. N. Brook; P/O. C. H. Brown; Sgt. W. J. R. Hammond; A/C.1 C. H. Hore; L.A/C. V. Nuttall.

PREVIOUSLY REPORTED WOUNDED OR INJURED ON ACTIVE SERVICE, NOW REPORTED DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Sgt. J. W. Arnott.

DIED ON ACTIVE SERVICE.—Cpl. W. T. Avery; L.A/C. D. Bailey; A/C.1 F. Brown; A/C.2 T. Davidson; Sqn. Ldr. H. S. Davis; L.A/C. E. C. Ellis; A/C.2 L. V. Fletcher; Cpl. C. Garwood; L.A/C. F. Gilleard; Sgt. M. T. Hare; A/C.1 E. J. Jarvis; Cpl. J. E. Jones; Act. Sqn. Ldr. A. Kemsley, D.S.M.; A/C.2 G. Lamb; A/C.1 J. L. Leach; L.A/C. L. D. P. Lucas; Cpl. W. E. Lock; A/C.2 J. F. Mahoney; L.A/C. D. A. Monger; A/C.1 L. O'Halloran; Cpl. A. S. Poulter; Cpl. A. Robertson; Wing Cdr. P. R. Robinson; L.A/C. C. F. Russell; A/C.1 R. Semple; A/C.2 E. F. Sheppard; A/C.1 R. R. Simm; A/C.2 W. Smallman; A/C.1 H. T. Stevens; P/O. C. H. Stone; L.A/C. W. C. C. Stratton; A/C.1 S. R. Vidler; A/C.2 R. G. Vosper; A/C.2 A. J. Wakins; Flt. Sgt. E. G. Williams; A/C.2 W. A. Wilson.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW REPORTED PRISONER OF WAR.—Sgt. K. P. Collins.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—F/O. R. J. E. Boulding; Sgt. L. N. Chappell; Sgt. A. R. Dawson; P/O. E. Hewson; Sgt. G. Leather; Sgt. W. C. McCorkell; P/O. P. P. Villa.

Amendment to Communique 75.

MISSING.—For P/O. Pritchard, P. H. H., read Act. F/O Pritchard, P. H. H. W.A.A.F.

DIED ON ACTIVE SERVICE.—Assist. S/O. J. Pipon.

Royal Australian Air Force

WOUNDED OR INJURED IN ACTION.—Flt. Lt. T. V. Stokes.

MISSING.—Sgt. E. V. K. Higgins; P/O. J. Lee; P/O. R. A. Mallock; P/O. J. H. O'Byrne.

KILLED ON ACTIVE SERVICE.—Sgt. R. K. Down; Sgt. N. A. Evans; Act. Sgt. E. C. Jago.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. R. J. Cowan; Sgt. O'Donnel; P/O. A. L. Walker.

DIED ON ACTIVE SERVICE.—Sgt. G. Pyke.

Royal Canadian Air Force

KILLED IN ACTION.—Sgt. W. E. Gibb; P/O. J. A. Maxwell; Sgt. W. R. B. Belyea.

WOUNDED OR INJURED IN ACTION.—Sgt. G. K. Higgins.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. M. G. A. C. Casgrain; P/O. G. K. Coates; Sgt. J. A. Cover; Sgt. F. J. Hart; Sgt. W. J. R. Hartry.

MISSING.—P/O. T. K. Coupland; Sgt. W. M. G. Dunham; Sgt. H. P. Hartridge; Sgt. J. M. Jarvis.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—Sgt. S. T. McNeill; Sgt. H. G. Peel.

KILLED ON ACTIVE SERVICE.—P/O. H. D. Abrams; Sgt. D. G. Calderone; Sgt. W. D. Gilbert; P/O. R. F. Minnick.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. V. W. Swindon.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—P/O. R. E. Buckolz.

Royal New Zealand Air Force

KILLED IN ACTION.—Sgt. D. C. Joyce; Sgt. F. H. Laing; P/O. G. M. Marshall.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. G. T. Kimberley; Sgt. W. A. Watts.

MISSING.—Sgt. C. W. Andrews; Act. Flt. Lt. A. B. Baird; Sgt. C. B. Barton; Sgt. S. A. Dyer; Sgt. M. Evans, D.F.M.; Sgt. R. E. E. Fotheringham; Sgt P. E. Hare; P/O. M. S. Lund; Sgt. E. C. McDonald; Sgt. D. M. McKinnon; Sgt. A. R. Tout.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—P/O. S. C. Parton.

South African Air Force

KILLED IN ACTION.—Lt. J. Conradie.

MISSING.—Capt. J. A. Kok; Capt. A. Maasz; 2/Lt. A. Ruffell; 2/Lt. A. A. L. Tatham; Lt. A. A. Tennant.

KILLED ON ACTIVE SERVICE.—2/Lt. B. A. W. Blatherwick; Air Sgt. J. S. Dunn; Air Sgt. A. R. Fowler; Lt. D. E. McConnell.

ROYAL PUPIL : Prince Bernhard of the Nederlands in the cockpit of a Miles Master at an R.A.F. training station.